# THE JOURNAL OF GAS LIGHTING
## WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LVII. No. 1463.] LONDON, MAY 26, 1891. [43RD YEAR. Price 6d.



**WOLSTON'S** Paste and Ready Mixed for Use.

Guaranteed Free from Adulteration. **TORBAY PAINTS.**

FOR GASHOLDERS, &c., &c.

**The Original "Torbay Paints"**
As supplied during the present and many preceding years to the LONDON GASLIGHT & COKE COMPANY.

*Special Quotations to Gas Companies.*

**TORBAY & DART PAINT Co., Ld.,**
23, Gt. George St., Westminster, S.W.
Works: DARTMOUTH, DEVON.

— ESTABLISHED 1830. —
**PARKER & LESTER,**
Manufacturers & Contractors.

THE ONLY MAKERS OF
**PATENT ANTIMONY PAINT,**
**Parker's Imperial Black Varnish,**
*Oxide Paints, Oils, and General Stores for Gas and Water Works.*

WORKS:
ORMSIDE STREET, OLD KENT ROAD, LONDON.

**Ashmore, Benson, Pease, & Co., Ld.,**
STOCKTON-ON-TEES,
Manufacturing Gas Engineers.
*See Advertisement, p. 1042.*

**CEMENT**
**EARLE'S**
BEST
**Portland Cement**
MANUFACTURED BY
GEO. & THOS. EARLE,
HULL.
Office: 7, PIER STREET.
Works: WILMINGTON.
STOREAGE CAPACITY 10,000 Tons.

ESTABLISHED 1811—OVER THREE QUARTERS OF A CENTURY.
Telegraphic Address: "CEMENT HULL."

**J. UNGAR & CO.,**
Manufacturers & Patentees of every Description of
**IMPROVED LAMPS**
FOR
**Streets, Markets, Shops, &c.**
*WHOLESALE DEPOT: 52, COMMERCIAL ST., LONDON, E.*
*We specially solicit Government and Local Board Contracts for General Lighting.*

**MELDRUM'S PATENT SELF-CONTAINED**
# Dust Fuel Furnace
Burns any kind of WASTE FUEL to advantage.
**OVER 300 SUCCESSFULLY WORKING.**

FOR PARTICULARS APPLY TO
# MELDRUM BROS.,
## Atlantic Works, 13, City Road,
## MANCHESTER.

Telegrams: "MELDRUM, MANCHESTER." National Telephone: No. 1674.

# DANIEL HOWARD,

(Successor to the late BENJ. WHITEHOUSE),

## GASHOLDER & BOILER WORKS,

**WEST BROMWICH, NEAR BIRMINGHAM**

(ESTABLISHED 1765),

## MANUFACTURER OF TELESCOPIC AND SINGLE GASHOLDERS,

WROUGHT AND CAST IRON TANKS FOR DITTO,

*PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,*

**Wrought-Iron Roofs, Bridges, Girders, &c.,**

Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

DRAWINGS, SPECIFICATIONS, AND ESTIMATES SUPPLIED ON APPLICATION.

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# EDWARD COCKEY & SONS, Ld.,

ESTABLISHED OVER HALF A CENTURY.

**Gas Engineers and Contractors for the Erection of Gas-Works.**

MANUFACTURERS OF IMPROVED GAS-EXHAUSTING APPARATUS.

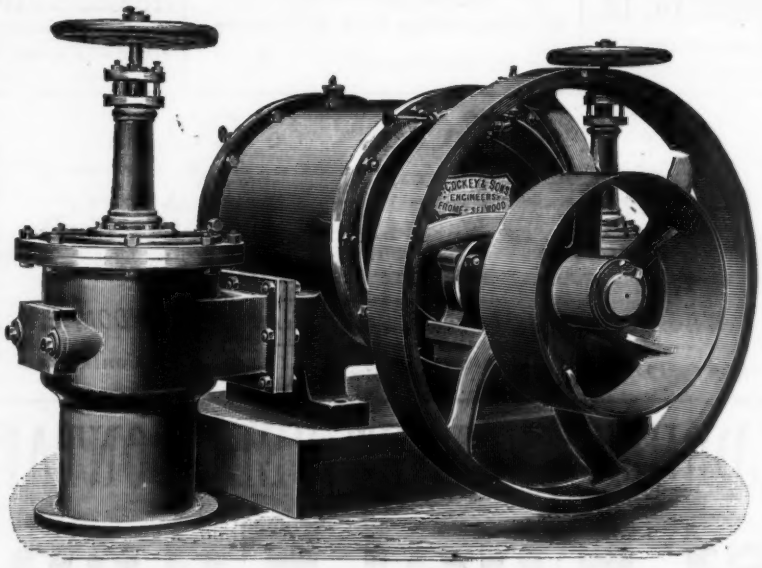
*A Large Stock of Valves always on hand.*

*Lamp Columns; various patterns.*

*Wood Grids for Purifiers and Scrubbers.*

*Castings of every description.*

*Apparatus for the manufacture of Sulphate of Ammonia.*




*Experienced Retort-Setters constantly employed.*

*Lead Burning and Plumbing in all its Branches.*

*Gas-Fittings in great variety.*

*Brass Castings.*

*Patent Washers and Valves.*

*Boilers and Engines.*

**THE IRON-WORKS, FROME SELWOOD, SOMERSET.**

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*HIGHEST AWARDS—LONDON, PARIS, COLOGNE, VIENNA, MELBOURNE, AND OTHERS.*

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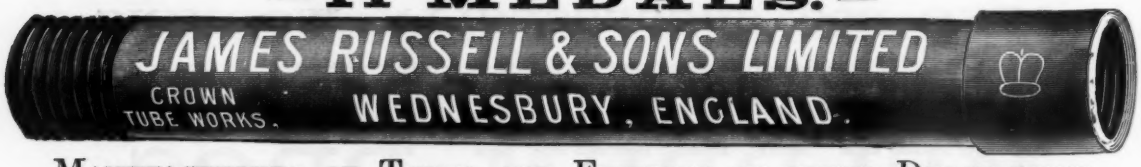


MANUFACTURERS OF TUBES AND FITTINGS OF EVERY DESCRIPTION.

**WROUGHT-IRON OR STEEL MAINS UP TO 6 FEET DIAMETER, FOR GAS, WATER, OIL, OR OTHER PURPOSES.**

SCREWING TACKLE, BOILER MOUNTINGS, VALVES, COCKS, ETC.

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LEEDS: 6, Mark Lane, New Briggate.

# THOMAS PIGGOTT & CO., BIRMINGHAM.

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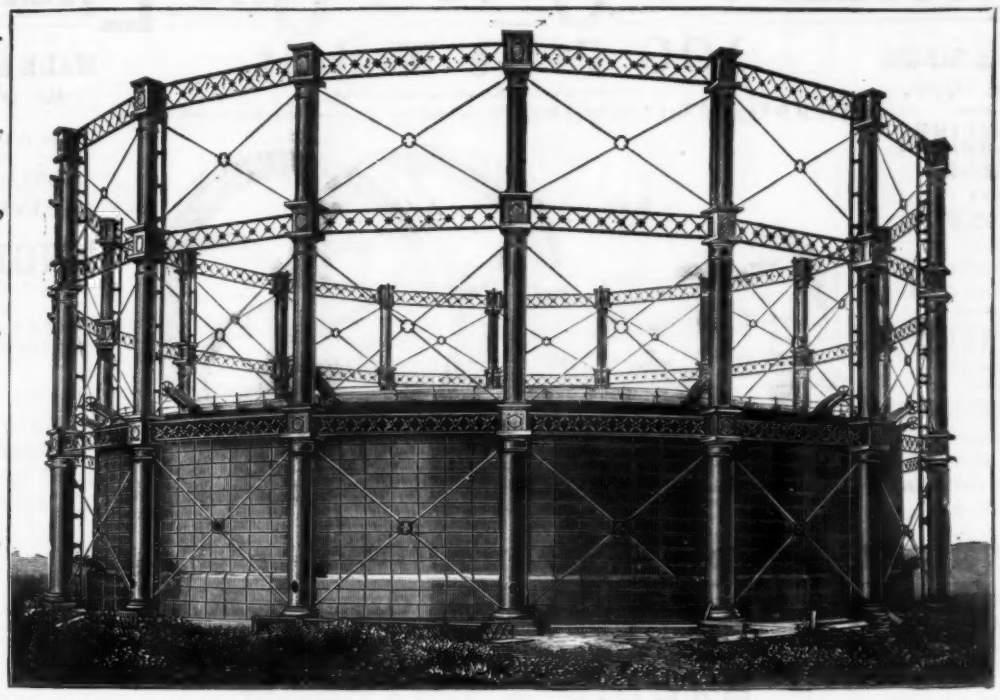
GAS PLANTS, BOILERS, ENGINES, PUMPS, ROOFS, RETORT FITTINGS, ETC.



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WELDED & RIVETED PIPES, FOUL MAINS, RETORT LIDS, WROT & CAST TANKS, PURIFIERS.

## OVER 500 GASHOLDERS HAVE BEEN SUPPLIED AND ERECTED,

INCLUDING THOSE SUPPLIED TO THE FOLLOWING GAS COMPANIES AND CORPORATIONS:

| | | | | | | |
|---|---|---|---|---|---|---|
| BATH. | BOLTON. | BRISTOL. | CHELTENHAM. | LEAMINGTON. | PRESTON. | SHEFFIELD. |
| BELFAST. | BOMBAY. | BRISBANE. | HARTLEPOOL. | LIVERPOOL. | READING. | STOCKHOLM. |
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# GAS COAL.

BEST

## REAL OLD SILKSTONE GAS COAL,

Address, THE STRAFFORD COLLIERIES COMPANY,

Near BARNSLEY, SOUTH YORKSHIRE.

# NEWTON, CHAMBERS, & CO., LIMITED

THORNCLIFFE IRON-WORKS, near SHEFFIELD,

MANUFACTURERS OF

SLIDE VALVES, WITH RACK & PINION, OR Internal or External SCREWS, of all Sizes.

GASHOLDERS, AND Gasholder Tanks.

CAST-IRON RETORTS,

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*And Retort-House Appliances*

of every description.

Iron Roofs, Columns, Girders, Floor Plates and Tools, &c.

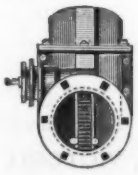
WROUGHT AND CAST IRON CONDENSERS, SCRUBBERS, & WASHERS,

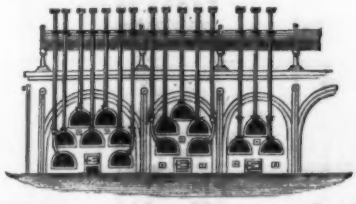
TAR AND LIQUOR PUMPS, &c.

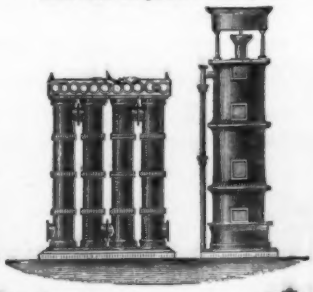
PATENT CENTRE VALVES

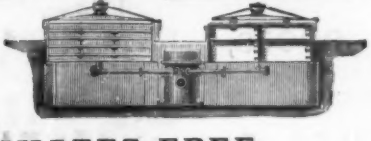
for working Purifiers.

Also Bye-Pass & Stop Valves









PURIFIERS with Planed Joints,

HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS and SPECIALS,

WOOD GRIDS.

CAST AND WROUGHT IRON TANKS AND CISTERNS.

DESIGNS, SPECIFICATIONS, AND ESTIMATES FREE.

Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

## GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

# CROSSLEY'S "OTTO" GAS-ENGINE.

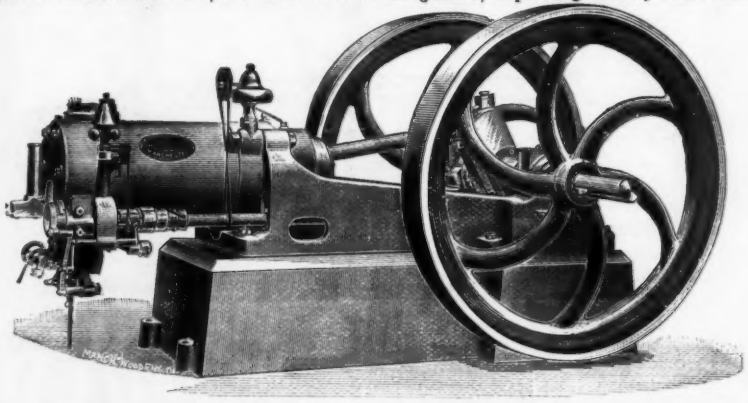
**100 Prize Medals.**

MADE in SIZES
2-Man to 100-HP.

GAS-ENGINES
COMBINED
WITH
PUMPS
FOR
TOWNS SUPPLY,
SEWAGE, &c., &c.

GAS-ENGINES
COMBINED
WITH
AIR COMPRESSORS
FOR THE
SHONE SEWAGE
SYSTEM, LUCIGEN
LIGHT, &c.

New 14-H.P. Nominal Size, fitted with Patent Tube Ignition, dispensing entirely with Plates.



MADE in SIZES
2-Man to 100-HP.

VERTICAL
AND
HORIZONTAL
TYPES.

ENGINES
*COMBINED*
WITH
HOISTS, PUMPS,
DYNAMOS, &c., &c.

*Largely used for*
*EXHAUSTING,*
*PUMPING,*
*COKE CRUSHING,*
*ELECTRIC LIGHTING,*
&c., &c.

Over 31,000 "OTTO" ENGINES are at work.

**CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER,**

LONDON,
LIVERPOOL,
GLASGOW,
NEWCASTLE,
BIRMINGHAM,
HULL.

## HARRIS & PEARSON,

**STOURBRIDGE, ENGLAND.**

MANUFACTURERS OF

FIRE-CLAY GAS-RETORTS, FIRE-BRICKS, LUMPS, & TILES of Every Description.

GLAZED BRICKS AND PORCELAIN BATHS.

# THE HORSELEY CO., LTD., TIPTON, STAFFORDSHIRE,

MAKERS OF **GAS HOLDERS & GAS PLANT,**

PURIFIERS, SCRUBBERS, CONDENSERS, WASHERS, TANKS, VALVES,

PIPES, LAMP PILLARS, RETORT-FITTINGS, ETC.

ALSO ALL KINDS OF

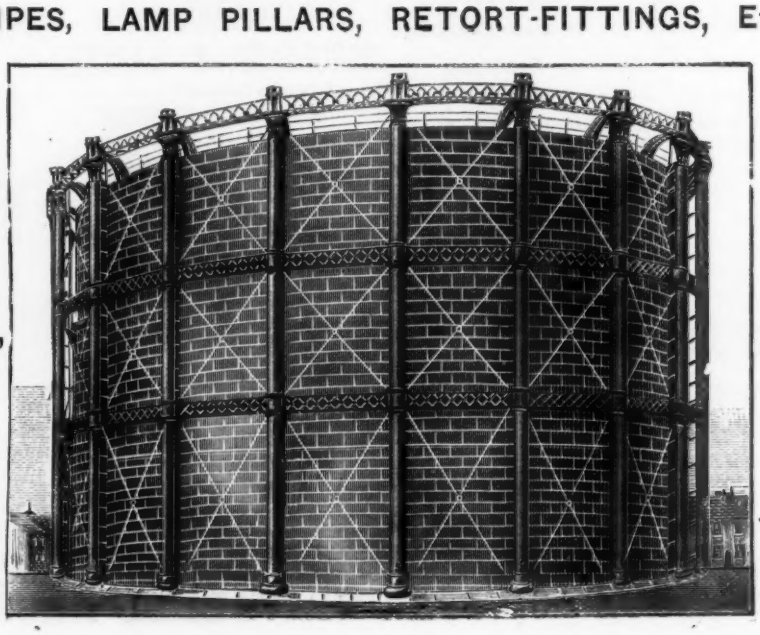
STRUCTURAL IRON

AND STEEL WORK,

BRIDGES,

ROOFS,

PIERS, ETC.



WORKS & HEAD OFFICE:
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LONDON OFFICE:
11, VICTORIA ST.,
WESTMINSTER.

TELEGRAPHIC ADDRESSES
"HORSELEY, TIPTON."
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# JOSEPH CLIFF & SONS,

INCORPORATED IN
THE LEEDS FIRE-CLAY COMPANY, Ltd.,
WORTLEY, LEEDS.

LONDON Offices & Depôts:
*Baltic Wharf, Waterloo Bridge.*

WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.

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*16, Lightbody Street.*

LEEDS:
*Queen Street.*

MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

**Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.**

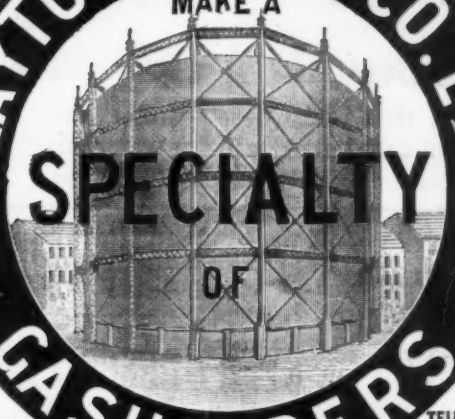
ESTABLISHED MORE THAN A QUARTER OF A CENTURY

WORKS HUNSLET, LEEDS

LONDON OFFICE: 60, QUEEN VICTORIA STREET E.C.

CLAYTON SON & CO. LTD.

MAKE A SPECIALTY OF GASHOLDERS



AND MAKERS OF GAS PLANT OF EVERY DESCRIPTION.

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# R. & J. DEMPSTER,

GAS PLANT WORKS, NEWTON HEATH, MANCHESTER,

MAKERS AND ERECTORS OF

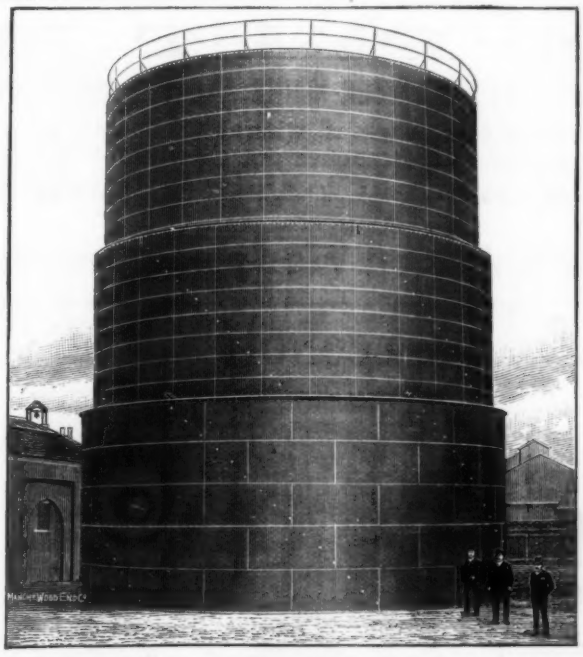
## PATENT COLUMNLESS GASHOLDERS.

*Telegraphic Address: "SCRUBBER MANCHESTER."*

**TOTAL WEIGHT REDUCED**
from 30 per cent. to 50 per cent.

**TRANSPORT AND ERECTION REDUCED**
to the same extent; and in cases where gasholders are shipped abroad to places difficult of access, this represents a very large amount of money.

**TANK CONSTRUCTION SIMPLIFIED.**
The Tank wall (of whatever construction) is a regular cylinder. There are no piers needed, and all expensive foundation stones for the base of columns or standards are dispensed with.



Two-Lift Gasholder recently erected, in a wrought-iron Tank, for the Birmingham Oxygen Company, at their Works, Saltley, Birmingham. The bottom of the Tank is fixed level with the ground, upon a concrete foundation.

**COST OF PAINTING SAVED**
for the Columns and Girders.

**TILTING UTTERLY IMPOSSIBLE;**
And as there are fewer parts, there is less liability for the Gasholder to get out of order in working.

**STABILITY UNDER WIND PRESSURE**
of a Gasholder constructed upon this system is at least equal to, and from experiments and calculations made is far in excess of, that of a Holder of the same dimensions guided by the elaborate guide framing at present in use

The removal of heavy guide carriages and rollers from the top curbs considerably lowers the centre of gravity of the structure, and dispenses with the extra strength of sheeting necessary to carry these at the points where they are attached to the gasholder.

The plan adapts itself to telescoping to any reasonable extent, and enables very shallow holders or lifts to be employed with perfect stability.

**FOR FURTHER PARTICULARS AND ESTIMATES, APPLY TO THE ABOVE.**

# JOHN HALL & CO.,

**STOURBRIDGE,**

**MANUFACTURERS OF FIRE-BRICKS, LUMPS, TILES,**

**AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.**

**RETORTS CAREFULLY PACKED FOR SHIPMENT.**

**A STOCK OF DIFFERENT SHAPES ON HAND.**

# GAS AND WATER PIPES

AND

# CASTINGS OF EVERY DESCRIPTION.

**MANUFACTURED BY THE**

# CLAY CROSS COMPANY,

## CHESTERFIELD.

| TRADE | TELEGRAMS: | LONDON AGENTS: |
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| C X C | "JACKSON" | BECK & Co., |
| MARK. | CLAY CROSS. | 130, GT. SUFFOLK ST., S.E. |

# SULPHATE OF AMMONIA.

By Her Majesty's Royal Letters Patent.

# DR. FELDMANN'S APPARATUS.

**The most successful and approved Apparatus known up to the present time.**

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICES APPLY TO THE

**Sole Agents and Manufacturers,**

## GODDARD, MASSEY, & WARNER,

## ENGINEERS,

## NOTTINGHAM.

**The Apparatus has been supplied to the following Firms–**

BURT, BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
CHANCE BROTHERS, OLDBURY (4 Apparatus).
RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

**And to the following Gas Companies and Corporations–**

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| ILKESTON. | BURY. | CHORLEY. |
| WIDNES. | BRIGHOUSE. | WHITEHAVEN. |
| HALIFAX. | MARKET HARBRO'. | CHESTER. |
| ALTRINCHAM. | PRESCOT. | SOUTH SHIELDS. |
| DENTON. | SOWERBY BRIDGE. | LEEK. |
| ST. ALBANS. | LEICESTER. | IPSWICH. |
| DUKINFIELD. | DARWEN. | BOURNEMOUTH. |
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| HUDDERSFIELD. | ORMSKIRK. | LUTON. |
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# RUSCOE'S PATENT MACHINE

## FOR DRILLING AND TAPPING WATER-MAINS AND GAS-MAINS UNDER PRESSURE.

Patent Saddle Back and Drilling Apparatus, whereby Gas and Water Mains can have 2-in., 3-in., 4-in., 5-in., and 6-in. Branches put on without loss of Water or Gas.

**Sole Maker of HELPS' PATENT PIPE EXTRACTOR.**

Prices and Particulars on Application to

## JOHN RUSCOE, Albion Works, Hyde, near Manchester.

## SIXTY PER CENT. ECONOMY IN GAS LIGHTING.

# The Schülke Regenerative Lamp

FOR

**DOMESTIC AND EXTERNAL LIGHTING.**

The only Regenerative Lamp employing the Common Flat-Flame Burners.

Lamps giving 20-Candle power consume less than four feet of Gas per hour.

**PURE WHITE & PERFECTLY STEADY LIGHT,**

NOT AFFECTED BY DRAUGHTS.

Suitable for any existing fittings (Brackets or Suspending).

Can be fixed in a few minutes.

May be seen at the Offices of the

## SCHÜLKE GAS-LAMP Co.

LIMITED,

**20, HIGH HOLBORN,**

LONDON, W.C.,

Where Price Lists and full particulars may be obtained.

# KIRKHAM, HULETT, & CHANDLER, LIMITED.

[Mr. SIDNEY HERSEY, Managing Director.] ADDRESS AT FOOT. [Mr. J. CHANDLER, Engineer.]

## 416 Patent "Standard" Washer-Scrubbers,

**Equal to a Daily Capacity of 374,700,000 Cubic Feet of Gas,**

*Erected and in course of construction at present date, amongst them being the following, viz.:—*

**(All new machines are supplied with improved wooden washing devices—"Bundles"—which can also be fitted to old Washers)**

| | Capacity. Cubic feet per day. |
|---|---|
| Altrincham | 600,000 |
| Adelaide | 600,000 |
| Aldershot | 200,000 |
| Allegheny, U.S.A. | 1,000,000 |
| Ashton-under-Lyne | 1,250,000 |
| Amsterdam | 1,500,000 |
| " | 1,500,000 |
| Annaberg | 200,000 |
| Arcachon | 100,000 |
| Animal Charcoal Co. | 200,000 |
| Altoona, U.S.A. | 350,000 |
| Buxton | 250,000 |
| Bradford | 1,000,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,000,000 |
| " | 1,000,000 |
| " | 3,000,000 |
| Bremen | 150,000 |
| Baltimore, U.S.A. | 1,000,000 |
| " | 1,000,000 |
| " | 1,000,000 |
| Balmain, N.S.W. | 125,000 |
| Bishops Stortford | 150,000 |
| Blackpool | 400,000 |
| Brussels | 1,250,000 |
| " | 1,250,000 |
| " | 750,000 |
| " | 1,250,000 |
| Banbury | 250,000 |
| Birmingham | 5,000,000 |
| Birkenhead | 2,500,000 |
| Blackburn | 1,500,000 |
| Bochum | 600,000 |
| Burntisland | 250,000 |
| Boston, U.S.A. | 2,000,000 |
| Brisbane | 1,500,000 |
| " | 300,000 |
| Burton-on-Trent | 1,500,000 |
| Barcelona | 350,000 |
| Barking | 100,000 |
| Baerlien & Co. | 20,000 |
| " | 420,000 |
| Bombay | 700,000 |
| Buffalo, U.S.A. | 550,000 |
| " | 500,000 |
| Brooklim, U.S.A. | 300,000 |
| Bergen | 250,000 |
| Berlin | 150,000 |
| Bournemouth | 1,000,000 |
| Bridgeport, U.S.A. | 500,000 |
| Brunswick | 300,000 |
| Beck & Co., St. Louis | 100,000 |
| Barmen Rittershausen | 600,000 |
| Bexhill | 125,000 |
| Brooklyn, U.S.A. | 1,000,000 |
| " | 1,000,000 |
| Brunner, Mond, & Co. | 400,000 |
| Cheltenham | 2 000,000 |
| Cannes | 200,000 |
| Croydon | 1,500,000 |
| Copenhagen | 200,000 |
| Clevedon | 200,000 |
| Columbus, U.S.A. | 500,000 |
| Cincinnati, U.S.A. | 1,500,000 |
| " | 1,500,000 |
| Chicago, U.S.A. | 3,000,000 |
| " | 1,000,000 |
| " | 1,000,000 |
| Chemnitz | 1,000,000 |
| Crewe | 1,250,000 |
| Colonial Gas-Works Co. | 100,000 |
| Cadiz | 300,000 |
| Charottenberg | 600,000 |
| Dudley | 750,000 |
| Driffield | 100,000 |
| Dukinfield | 500,000 |
| Dover | 750,000 |
| " | 1,000,000 |
| Deal | 200,000 |
| Derby | 1,500,000 |
| Dublin | 3,000,000 |
| Dowlais | 100,000 |
| Douai | 500,000 |
| Denton | 500,000 |
| Derby, U.S.A. | 350,000 |
| Denver, " | 500,000 |
| " " | 1,000,000 |
| Düsselldorf | 750,000 |
| " | 500,000 |
| Dumfries | 250,000 |
| Dunedin, N.Z. | 400,000 |
| Darlington | 1,250,000 |
| Detroit, U.S.A. | 750,000 |
| Edinburgh | 1,500,000 |
| " | 2,000,000 |
| Enfield | 300,000 |
| Essen | 300,000 |
| Elbing | 150,000 |
| Falmouth | 150,000 |
| Frankfort | 300,000 |
| Farnworth | 400,000 |
| Fenton | 400,000 |
| Friedenshütte | 500,000 |
| Fürth | 400,000 |
| Freiburg | 200,000 |
| Goole | 250,000 |
| Glossop | 300,000 |
| Guildford | 300,000 |
| Gloucester | 1,250,000 |
| Gera | 300,000 |
| Grafton, N.S.W. | 100,000 |
| Grieg | 300,000 |
| Georgetown, U.S.A. | 250,000 |
| Gluckauf | 200,000 |
| Heywood | 600,000 |
| Holywood | 125,000 |
| Huy | 70,000 |
| Harrow | 250,000 |
| Harrogate | 250,000 |
| Halstead | 150,000 |
| Heilbronn | 200,000 |
| Havanna, Cuba | 750,000 |
| Hastings | 1,500,000 |
| Huddersfield | 300,000 |
| " | 750,000 |
| " | 1,500,000 |
| Hof | 200,000 |
| Hampton Wick | 500,000 |
| Heckmondwike | 500,000 |
| Haverfordwest | 100,000 |
| Halifax, N.S. | 350,000 |
| Hamm | 200 000 |
| Halle | 400,000 |
| Heidelberg | 300,000 |
| Hartford, U.S.A. | 1,000,000 |
| Ilkeston | 300,000 |
| Inverness | 250,000 |
| Ilkley | 200 000 |
| Ilford | 100,000 |
| Kingston-on-Hull | 400,000 |
| Kidderminster | 750 000 |
| Kidsgrove | 100,000 |
| Königsberg | 1,000,000 |
| King's Lynn | 300,000 |
| **LONDON:—** | |
| The Gaslight and Coke Co.:— | |
| Beckton | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 2,500,000 |
| " | 2,500,000 |
| Silvertown | 1,000,000 |
| Bromley | 2,000,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| " | 2,000,000 |
| " | 1,500,000 |
| Shoreditch | 2,500,000 |
| LONDON—*Continued.* | |
| Pancras | 1,500,000 |
| " | 1,500,000 |
| Pimlico | 2,000,000 |
| Nine Elms (2) | 3,000,000 |
| Kensal Green (2) | 3,000,000 |
| South Metropolitan Co.:— | |
| Greenwich | 3,000,000 |
| Woolwich | 400,000 |
| Vauxhall | 3,000,000 |
| " | 3,000,000 |
| Lea Bridge | 300,000 |
| West Ham | 1,500,000 |
| " | 3,000,000 |
| Leeds | 2,000,000 |
| " | 3,000,000 |
| " | 3,000,000 |
| " | 3,000,000 |
| " | 3,000,000 |
| " | 2,000,000 |
| Leominster | 150,000 |
| Leiden | 560,000 |
| " | 600,000 |
| Liverpool | 2,000,000 |
| " | 2,000,000 |
| " | 2,000,000 |
| " | 2,000,000 |
| " | 2,000,000 |
| " (3) | 3,000,000 |
| Lincoln | 1,000,000 |
| " | 600,000 |
| Lowell, U.S.A. | 1,000,000 |
| Laclede, " | 1,000,000 |
| Louisville " | 1,500,000 |
| Long Eaton | 500,000 |
| Lille | 900,000 |
| " | 450,000 |
| " | 750,000 |
| " | 250,000 |
| " | 250,000 |
| Luckenwalde | 330,000 |
| Liegwitz | 300,000 |
| Lincoln, U.S.A. | 250,000 |
| Lawrence, " | 500,000 |
| Lynn, " | 300,000 |
| Lyons | 1,500,000 |
| Maidstone | 1,000,000 |
| Marseilles | 1,500,000 |
| " | 1,500,000 |
| Mons | 500,000 |
| Malines | 250,000 |
| Melbourne | 1,500,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| Manchester | 2,500,000 |
| Middleton | 400,000 |
| Manley, N.S.W. | 100,000 |
| Minneapolis, U.S.A. | 750,000 |
| Magdeburg | 3 0,000 |
| Memphis, U.S.A. | 750,000 |
| Nottingham | 1,250,000 |
| " | 2,500,000 |
| " | 2,500,000 |
| " | 2,000,000 |
| " | 1,500,000 |
| " | 2,000,000 |
| Newport, U.S.A. | 480,000 |
| Newmarket | 150,000 |
| Newark, U.S.A. | 680,000 |
| Northfleet | 200,000 |
| New York, U.S.A. | 2,000,000 |
| Nice | 600,000 |
| Newcastle, N.S.W. | 200,000 |
| Numea, " | 100,000 |
| Namur | 250,000 |
| Newark | 350,000 |
| Nassau, U.S.A. | 1,000,000 |
| Oldbury | 500,000 |
| Otley | 200,000 |
| Oswestry | 250,000 |
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| Otto & Co.'s Coke Works | 1,500,000 |
| Plymouth | 2,000,000 |
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| Prescot | 150,000 |
| Providence, U.S.A. | 750,000 |
| " " | 750,000 |
| Plauen | 300,000 |
| " | 300,000 |
| Portsmouth | 2,500,000 |
| " | 2,500,000 |
| Pittsburg, U.S.A. | 1,500,000 |
| Portland, " | 560,000 |
| Pawtucket " | 500,000 |
| Quebec | 250,000 |
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| Rouen | 250,000 |
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| Reigate | 200,000 |
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| Richmond | 1,500,000 |
| Reading | 2,000,000 |
| Reichenbach | 200,000 |
| Salford | 1,750,000 |
| " | 1,750,000 |
| " | 1,750,000 |
| Smethwick | 750,000 |
| Sydney, N.S.W. | 1,000,000 |
| " | 1,000,000 |
| " | 2,500,000 |
| " | 50,000 |
| " | 50,000 |
| Sunderland | 1,500,000 |
| St. Joseph's, U.S.A. | 250,000 |
| Spa | 100,000 |
| Sevenoaks | 300,000 |
| St. Petersburg | 2,000,000 |
| " | 1,500,000 |
| St. Louis, U.S.A. | 2,000,000 |
| " | 2,000,000 |
| " | 1,000,000 |
| Silesian Coal Co. | 600,000 |
| San Francisco, U.S.A. | 2,000,000 |
| " | 2,000,000 |
| Sheepbridge Coal Co. | 40,000 |
| Stettin | 200,000 |
| Singapore | 300,000 |
| Sutton | 500,000 |
| Tonbridge | 150,000 |
| Tipton | 400,000 |
| Tottenham | 1,000,000 |
| Toledo, U.S.A. | 750,000 |
| Toronto | 1,000,000 |
| Uxbridge | 300,000 |
| Valparaiso | 500,000 |
| West Bromwich | 1,000,000 |
| Willenhall | 250,000 |
| Weston-super-Mare | 500,000 |
| Waltham | 150,000 |
| Wormwood Scrubbs | 300,000 |
| Williamsburg, U.S.A. | 600,000 |
| " " | 600,000 |
| Wellington | 150,000 |
| Warwick | 300,000 |
| Wheeling, U.S.A. | 500,000 |
| Walker | 300,000 |
| Westgate | 100,000 |
| Wilmington, U.S.A. | 500,000 |
| Windsor, N.S.W. | 100,000 |
| Wolverton | 100,000 |
| Wellington, N.Z. | 250,000 |
| Whitchurch | 175,000 |
| Washington, U.S.A. | 2,000,000 |
| Wallasey | 750,000 |
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[See also Advt., p. 998.

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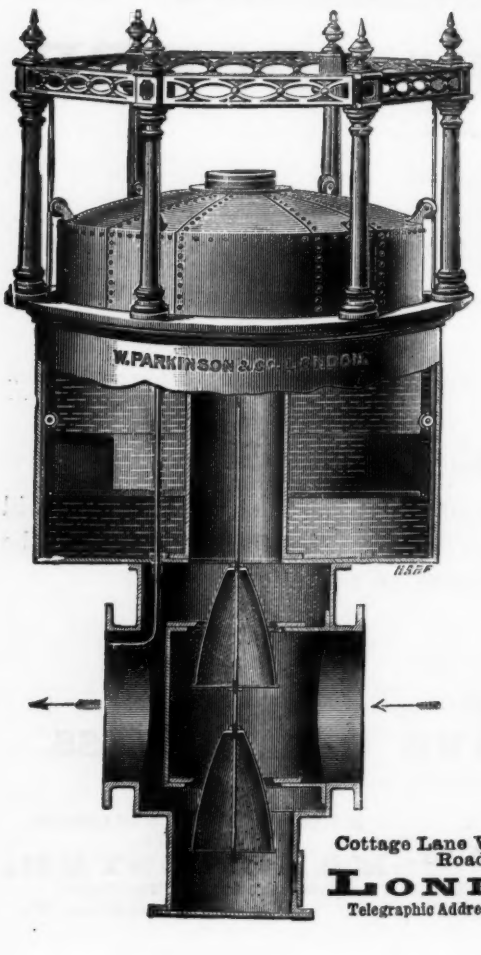


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THE

# JOURNAL OF GAS LIGHTING,

## WATER SUPPLY, & SANITARY IMPROVEMENT.

*TUESDAY, MAY 26, 1891.*


### Lord Salisbury on Municipal Legislation.

One of the events of the past week was the visit of the Marquis of Salisbury to Glasgow, in order to receive the freedom of the city, which, of course, involved the delivery by the illustrious burgess and guild-brother of a couple of speeches. With one of these we have here no concern; and the same observation applies to a portion of the other. There is one part of Lord Salisbury's second Glasgow address, however, to which it is advisable to draw the attention of some readers of the Journal, in their capacity of representatives of a great industry which has relations with Parliament on the one side, and with local authorities on the other. It is the Home Rule portion of the Prime Minister's speech at the Lord Provost's luncheon last Wednesday afternoon which strikes us as possessing very special interest for so many of our readers; and the reason for this is soon explained. Lord Salisbury was speaking of the difficulty of getting legislative work done in Parliament; and he went so far as to exalt the business capacity of municipalities in comparison with that of the House of Commons. He described Parliament and the municipalities as "rather running a race against each other," in their mutual task of "providing laws for the government and "comfort of the people." There is a difference, of course, in the kind of laws passed by these two sorts of legislative organizations; but, in Lord Salisbury's opinion, the legislative work which is done by municipalities is better done in its degree than that performed by Parliament. "The "laws which the municipalities, within their powers, pass "are quickly despatched, carefully considered, conceived "in workman-like shape, and effect the results for which "they were designed. The laws that Parliament passes "are only passed after infinite and heartrending delay. "They appear in a crude and mutilated form. Every "salient point is rubbed down in order to enable them to "pass through the narrow channel that is open to them; "and the result at the end is that they have been so well "arranged and so well conceived that an amending Act is "necessary next year." Having this comparison in mind, the Prime Minister went on to say that he was so far a "Home Ruler" that "he should like to give to the muni-"cipalities, the municipal authorities, the oldest represen-"tatives of popular government in this country, the very "utmost powers in dealing with all legislation that is of "a business-like character."

It is not often that the Prime Minister makes speeches to popular audiences; and when he does, it is still more rare for him to talk darkly. Lord Salisbury's oratory is mainly of the light sarcastic order; but it is generally easy to understand. Upon this occasion, however, the Premier was hardly up to his usual form. Whether or not he had exhausted himself in his first speech, it is impossible to say; but, altogether apart from its matter, the style of the second address was very inferior to that of the oration which preceded it. It is not like Lord Salisbury to talk of laws as being "conceived in a workman-like shape." It would be open to a cynic to remark that an immediate effect of making the Prime Minister a burgess of Glasgow was seen in his speaking like a *bourgeois*. As to the matter spoken of, some allowance must doubtless be made for the circumstances and the occasion. A newly-enfranchised citizen is expected to say something complimentary of municipal institutions; and if he is a trifle fulsome at such a time, it is more easily forgiven him by his local auditory than coldness. No one would wish to take Lord Salisbury's after-luncheon speech at Glasgow more literally than the complimentary effusions of another person similarly situated; yet it is difficult to discover always, by mere textual criticism, when an eminent orator is giving his deliberately-formed sentiments, and when he is merely talking for the sake of gratifying his hearers. Thus, while we do not suppose that the Prime Minister intended to foreshadow any great scheme of legislative devolution by his praise of the law-making capacity of municipalities, it is equally unreasonable to imagine that he meant nothing by it. We are not about to essay the vain attempt of establishing what Lord Salisbury really and truly did mean on this occasion, by weighing textual evidence (which is a common enough amusement with followers of the Premier's great opponent), but are only solicitous to point out that there are two sides to the picture painted in such glowing hues by the newest and most eminent of Glasgow citizens, one of which we have the best warranty for discussing here.

For instance, when Lord Salisbury talks of the desirability of giving to municipalities "the very utmost powers "in dealing with all legislation that is of a business-like "character,' it is no great stretch of the language to say that this would cover the relinquishment to municipal authorities of supreme control over such matters as gas and water supply. If these things are not of a "business-like

"character," what is? Yet is there anybody who, upon reflection, would consign all the statutory interests of gas and water supply to municipal control? It would not have been necessary to go out of the City Chambers where Lord Salisbury ventilated his Home Rule aspirations to find a negative answer to this query; for among his hearers were surely some persons interested in the Partick, Hillhead, and Maryhill Gas Company, who would have fared badly enough if this concern had been left perforce to the tender mercy of the Glasgow Corporation. It is all very well to talk at large after luncheon about giving municipalities full legislative powers within their own districts; but when one stoops to inquire how the idea would be likely to work in typical cases, one is liable to find plenty of reasons for being thankful not only for the House of Commons, but also for the House of Lords in addition.

Lord Salisbury's wish is a very natural one, from a somewhat obvious standpoint; but it is not one that a prudent man would be in a hurry to express if the fairy gift of fulfilment were attached to the enunciation. It is one thing to relieve Parliament of responsibility for the details of legislation affecting business matters, and quite another thing to plump the responsibility directly upon the municipalities affected by these questions. Speaking generally, we do not see much objection in principle to allowing some of these responsibilities to devolve upon District or Provincial Councils, which might probably be trusted to see fair play even against the biggest Corporation in their midst; but single municipalities have already about as much responsibility as they can be trusted with. If no other objection to the extension of their legislative powers existed, a sufficient one would be found in their trading occupations. When a municipality supplies as well as governs, it obviously stands upon a different footing to that of any purely legislative body. But, in point of fact, there are plenty of other objections; and although it was not Lord Salisbury's cue to say so last Wednesday, he knows perfectly well that the party feeling and general imperfection of humanity which hinder the legislative work of Parliament, are just as operative in the pettiest local board as they are at St. Stephen's. We shall never get rid of the shortcomings of our politicians by spreading out the area in which they can operate.

Really, if it were not for the boldness of the charge, we should be tempted to accuse the Prime Minister of talking "claptrap" on this really historic occasion. It is by no means clear that if all so-called "business-like" legislation were taken away from Parliament to-morrow, the parliamentary machine would get on any faster for being so lightened. It is not the business Bills that block the way. Considering everything, it is easy enough to deal with any number of these. But it is the political measures that bring out the torrents of talk that turn the House of Commons into a Slough of Despond for Administrations; and the municipalities cannot drain off these floods of verbiage. If it comes to the point, however, we may ask: Where is the Parliament that does more work than our own, or better work, on the whole? This country has for neighbours, on the one side, France; on the other, the United States. Both nations have highly-developed parliamentary institutions; and in both, most of the business details referred to by Lord Salisbury are disposed of by extra-parliamentary agencies. In the States, practical legislative duties are localized, first in the State Legislatures, and then in the still more local elective administrative bodies. In France, the centralized bureaucracy and the local governing bodies relieve the Chamber of almost all practical work. What is the consequence? Congress and the French Chamber are mere debating societies compared with the British Parliament. Indeed, one might go farther, and argue that it is the fact that all sorts of localized and detail work is thrown upon our Parliament, which keeps the members up to their duty, and emphasizes their responsibility to the country. There is plenty of time for them to talk, and pick holes in one another for the general edification; but it is surely worth something, as a reminder of personal responsibility, that the most rabid of debaters must strain at the collar of Committee work when required, like the prosiest members of a Court of Quarter Sessions. After all, therefore, when one looks at the matter all round, it is possible to entertain a very sufficient respect for our local authorities, in their place and degree, while questioning whether it would be good, either for them or Parliament itself, to endow them with much more legislative power than they at present exercise.

### The Programme of The Gas Institute Meeting.

In another part of the Journal will be found the programme, as finally settled, of the Carlisle meeting of the Incorporated Gas Institute, which will open this day fortnight under the presidency of Mr. J. Hepworth, M. Inst. C.E. Business is to begin at eleven in the morning with a ceremonial reception by the Mayor and Corporation of Carlisle; and the usual inauguratory transactions will occupy the time till the hour for adjournment. The afternoon will be devoted to the reading and discussion of papers and communications, with a meeting of the donors and subscribers to the Benevolent Fund to follow. In the evening, members will be entertained at a smoking concert by the North of England Gas Managers' Association. On the following day, technical business will be resumed betimes, and persevered with until four o'clock, when the sitting will be suspended in order to permit of members visiting places of interest in the city. Wednesday evening will be signalized by a reception given in the County Hall by the Mayor of Carlisle (Mr. Alderman B. Scott, J.P.). Thursday will wind up the technical and formal business; the evening being set aside for the President's trip to Naworth Castle and Lanercost Priory. The great excursion of Friday will be to Keswick, for Derwentwater and the neighbourhood. This disposition of the time strikes one as businesslike, if rather more severe upon members than some previous programmes. With regard to the papers promised, it will be observed that our preliminary announcement of a month ago is borne out, with the difference that the expected extra contributions then referred to have not been forthcoming. It is difficult to predict the attractiveness of technical papers from their titles; and we therefore prefer, on this occasion, to name the subjects and authors of the ten communications in the list, in order that they may speak for themselves. Mr. W. R. Chester, of Nottingham, will read a paper "On some Bye-Products;" Mr. A. J. Edwards, of Taunton, will give his experiences of "Competition with the Electric Light;" Mr. C. S. Ellery, of Bath, will tell how he raised a retort-house roof; Mr. James M'Gilchrist, of Dumbarton, has to deal with coal storeage; Mr. Charles Nickson, of Manchester, will discourse on gas workers' strikes; Mr. T. N. Ritson, of Jersey, will describe his method of locally disposing of sulphate of ammonia; and Mr. W. J. Warner, of South Shields, promises to treat of the diaphragm, or measuring chamber, of dry gas-meters. Besides these contributions from members, there are to be three professional communications—from Professor Vivian B. Lewes, on carburetting methods; from Professor W. Foster, upon the effects of specific hydrocarbons upon the illuminating power of gas; and from Mr. A. T. Walmisley, M. Inst. C.E., upon wind pressure on roofs and gasholders. The technical matter for the consideration of the meeting is therefore, as we remarked on first hearing of the programme submitted to the Council, ample in amount and diversified in character. With good weather, the meeting ought to be both agreeable and profitable.

### The Manchester Gas Agitation.

There really seems to be some purpose actuating the Manchester citizens who are agitating, by public meetings, deputations to the authorities, and letters in the local newspapers, to obtain a reform of the administration of the city gas supply. It is to be hoped that those who are chiefly instrumental in getting up the present movement are prepared to keep at it until they gain their end; but this sort of thing is apt to grow wearisome when, month after month, and even year after year, goes by without appearing to bring the object nearer. Corporations have an immense power of resistance to popular pressure which is of a non-political kind; and there is great difficulty in translating a desire for cheap gas into a motive power at the November polls. The rock upon which most agitations of the kind split is ignorance of the facts. There is, perhaps, a good deal of vague dissatisfaction in a town with regard to the gas supply; and reformers flatter themselves that they are carrying the public with them. The danger is that, among the miscellaneous supporters of an intelligent programme of reform, there will be found some blatant grumblers whose sole idea is to punish the authorities for selling air, sending out imaginary bills, or some other time-dishonoured delusion of the discontented gas consumer. If any

such stock complaints gain admission to the popular scheme of reform, all chance of its success is lost. The authorities fasten upon this part of the indictment, to the exclusion of the rest; and by exhibiting it in a ridiculous light, they discredit the entire agitation. It would be a pity for the present Manchester movement in favour of cheaper gas to be spoilt in this way. The price charged for gas is due to considerations which every intelligent citizen and consumer can appreciate; but not so the question of the quality of the supply. Manchester is well—perhaps too well—off in analytical chemists; and there are many of these clever gentlemen on the side of the cheapness and purity agitation. It is not far from the truth to declare, as many of them do, that the official testing of Manchester gas for purity and illuminating power is a farce. What they have to do is to exhibit the truth of the matter, by employing an experienced Metropolitan Gas Examiner to do occasionally for Manchester gas what is done at so many places every day in the week for London gas. But, above all, our counsel to the Manchester gas reformers is: No delusions! If reform is demanded upon the grounds that the Manchester gas undertaking shall no longer send out dirty gas, or gas of irregular illuminating power, and that this fine property shall no more serve as a milch-cow for a spending department of the Corporation, nor shall any man who burns gas be more highly rated than his neighbour who burns oil, candles, or uses the electric light—then it is only a question of time and perseverance to obtain all the reform that is truly needed.

### The Gas Supply of Birmingham.

The Birmingham Corporation Gas Committee have issued their annual report. As was the case everywhere else, the manufacturing resources at the command of the department were sorely strained to meet the exceptional increase of demand for gas due to the severity of the past winter; and, consequently, the Committee have had to consider the provision that must be made, both at Saltley and at Windsor Street, for the future requirements of the vast manufacturing district supplied from these two stations. Fortunately, both works are so well laid out for extension of productive power, that a comparatively small outlay only will be required to bring up their output to about 10½ millions each per diem. After this, which is expected to suffice for the ensuing three or four years, a fresh start will have to be made. The report contains references to several interesting points of gas manufacture; mentioning among other things the intention of the committee to spend £4387 upon a further trial of inclined retorts—the settings already constructed at Windsor Street on this system being considered as justifying more extended experiment. With regard to improvements in purification, it is remarked that the working of the Claus system at Belfast on a large scale has not been sufficiently conclusive to justify the Committee in depending exclusively upon this system at present for the purification of the large output from their works. The Committee briefly mention the air and oxygen processes of purification with lime, or lime and oxide; and they announce their intention of spending £4880 upon trying air and lime purification, with reduction of sulphur compounds. The gross revenue of the Committee for the year ending March 31 last was £583,032; and their expenditure on revenue account, £451,786—leaving a profit balance of £131,246, of which £36,785 is ranked as "surplus profit." The year's history is not particularly eventful in other respects.

**Manchester District Institution of Gas Engineers.**—The eighty-sixth quarterly meeting of the members of this Institution will take place next Saturday, when, as usual in the spring, the Committee have arranged for an excursion. According to the programme issued by the Honorary Secretary (Mr. S. S. Mellor), a start will be made from the Central Station, Manchester, shortly after ten o'clock, for Cuddington, whence conveyances will take the party through Delamere Forest to the Swan Hotel, Tarporley, where luncheon will be served. A move will then be made to Beeston Castle, after inspecting which the members will return to Tarporley, where they will take tea together, and transact (under the presidency of Mr. T. O. Paterson, Assoc. M. Inst. C.E., of Birkenhead) the formal business on the *agenda*. This will consist simply of the confirmation of the minutes of the previous meeting, and the admission to the Institution of Mr. S. Crossland, of Holmfirth; Mr. R. Fearnley, of Rastrick; and Mr. H. H. Ford, of Macclesfield. The return to Cuddington will be made early in the evening—the route to be taken being *viâ* Easton, Oulton Park, Little Budworth, and Whitegate.

# THE INCORPORATED INSTITUTION OF GAS ENGINEERS.

## PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS, May 12 & 13, 1891.

Mr. G. C. Trewby, M. Inst. C.E., President.

We conclude to-day our report (commenced last week) of the technical portion of the business at the recent meeting of the above-named Institution.

### Discussion on the Papers by Messrs Goulden, Glasgow, and Foulis.

Mr. Vernon Harcourt said he had not had any practical experience in connection with the water-gas process, although when he was in New York he took the opportunity of seeing, and having explained to him, a process somewhat similar. There was only one suggestion which occurred to him as possibly worth making on the subjects before the meeting. He understood from the second paper that the American oils, which were produced in inexhaustible quantity, would be most proper for the purpose of enriching gas if it were not for the regulation—probably an expedient one—in force forbidding the storeage in large quantities of any oil below a certain flashing-point. It occurred to him that these oils, immediately on delivery, and before any large quantity had accumulated, might be placed in some kind of washer or scrubber, and have a stream of ordinary coal gas passed through them, when the effect would probably be to enrich the coal gas, and proportionately reduce the flashing-point of the oil. The lighter hydrocarbons which caused the low flashing-point would be volatilized and passed into the gas, increasing its illuminating power, and perhaps rendering the deposition of naphthalene less likely afterwards; while the oil itself would possibly have its flashing-point brought down to a sufficient degree to be safely stored. The extent to which this might be carried would probably be regulated by the proportion of gas passed through it, or by regulating the temperature. This could be raised either by passing the gas while still hot through the washer, or by heating the washer by means of a steam-pipe. He did not know if this suggestion was at all practicable; but it occurred to him, while listening to the paper, as a possible means of rendering available the large stores of American oils.

Mr. W. Foster remarked that he should much like to contribute something to the discussion, but was not in a position to do so, having regard to the extremely practical character of the papers. He had in his programme one or two ambitious schemes, one of which was to determine the equivalent of some hydrocarbon added to ordinary coal gas, so that he could say, if he were asked (as he had been), what it would cost to raise the illuminating power of gas one candle—say, from 16 to 17, from 20 to 21, or from 24 to 25 candles, as the case might be. He did not think anyone could at present refer with certainty to any published details of this kind. They knew that gasoline would do it; and Mr. Frank Clark, Mr. Frank Livesey, and some others, had had a good deal of experience in this respect. But there was one point which had not been enforced in the way he should like to see it; and that was the exact percentage of the specific hydrocarbon required for the purpose. This was what he contemplated taking in hand first. Dr. Frankland had done something. But he started at zero, taking hydrogen, and putting in methylene; and he obtained very valuable information indeed, which in the future would be looked to with some respect. But he (Mr. Foster) wanted to commence with something above the zero line, with a gas not hydrogen, though it must contain it, but which had a latent capacity for developing heat, such as marsh gas and other mixtures. If one started to work with such a gas at 16 candles, he (Mr. Foster) should like to know how much gasoline, or something more specific—say, Mr. Vernon Harcourt's pentane—would be required per unit of volume to produce a given effect in illuminating value. His own experience with reference to naphthalene, in experiments undertaken in

connection with the gas exhibition at the Crystal Palace, very much impressed him with the results that were obtained from naphthalene. Other figures had been published which were almost astounding as to the actual luminiferous value of particular hydrocarbons. Every one knew the difficulties sometimes experienced in dealing with naphthalene; but when one considered the effect of 5 lbs. of it when in combination with 1000 cubic feet of coal gas consumed in a burner, one saw the possibilities of these hydrocarbons, which were undoubtedly produced in the destructive distillation of heavy paraffin. The experiments he had made with Mr. Clark on the carburetting of ordinary coal gas were not sufficiently specific. They put in a certain quantity of gasoline, and obtained a certain effect; but this did not enable them to determine that which he was now trying to settle—viz., the effect of the progressive addition of a specific hydrocarbon on the illuminating value of such a mixture, going up the scale.

Dr. THORNE acknowledged that he had done very little indeed with water gas, though he had been engaged, to some small extent, on work connected with oil gas; and he quite agreed with those who stated that oil gas, as an enricher of either water gas or dry hydrocarbon gas, might be employed very largely and usefully in place in some instances of cannel. The extent to which this could be done of course required a great deal more experimental work. There was also one point just touched upon which was most important, and that was the different effect of an illuminating constituent on various gases. The amount of increased luminosity which a given quantity of oil gas or gasoline, or any of these illuminating substances, produced depended to a great extent on the constitution of the gas to which it was added. Where one had a 16-candle gas, containing (say) a large quantity of marsh gas, the increased illuminating effect given by the oil gas would be very much greater than where one had a gas of practically no illuminating power, containing next to no marsh gas, as in the case of all the water gases which had been made. The quantity of oil required to bring up the illuminating power of water gas must not by any means be taken as a criterion of its value for enriching coal gas. This was one of the points which should be kept in view; and the value of the oil as an enricher of poor coal gas must not be deprecated because of the large quantity required in producing carburetted water gas.

Mr. F. LIVESEY said one of the difficulties in the manufacture of water gas seemed to be that crude oil could not be used. From what he had heard, there was a large quantity of oil to be obtained, not only in Russia, but in Roumania and other parts of Europe, which could be delivered in England at much lower rates than the prices quoted; and he understood there were several processes in America which professed to use crude oil. He should like to know from Mr. Goulden or Mr. Glasgow why crude oil could not be employed in this apparatus, or whether any modification could be introduced which would enable it to be used. There were in Europe several oils which were not worth distilling for the purpose of obtaining kerosene, but which would immediately come into the market if they could be utilized in this way; and if they could be introduced, the oil being the principal item of expense, it would very considerably reduce the cost of water gas. There would then be many advantages—for instance, being able to start plant in a very short time in case of fog, or an alteration in the temperature; while with some gentlemen the labour question was also an important item. With regard to enriching gas with spirit, his own experience was that it was a very satisfactory process indeed from its extreme readiness; and it was certainly cheaper at the present price of cannel. The spirit they were now using was of a specific gravity of ·700; and with a proper apparatus, there was practically no condensation. A lighter spirit was more costly, but perhaps a little more sure. In some cases, when the apparatus was not quite efficient, there had been a slight condensation with this ·700 spirit; but with the others there was none. This might do something in removing the naphthalene trouble. If generally adopted, however, there would probably be so large a demand as to raise the price. He found the cost was about 1d. to 1½d. per candle per 1000 cubic feet.

Mr. A. F. BROWNE (Rotherhithe) said he did not know anything about water gas; but he had been making experiments within the last few months on gasifying oil. Mr. Foulis had omitted to mention one method which many engineers in London had recently tried—viz., introducing oil into the retort during the last half hour of the charge. This, he believed, was originally adopted at Carshalton—it was said with exceedingly good results; but, after trying it for a time at Rotherhithe, he obtained no satisfactory result at all. The oil was squirted into the retort during the last half hour, in precisely the same way in which it was said to be introduced at Carshalton; but he could discover no improvement whatever in the illuminating power. He therefore discontinued the method. But it was to be wished that some other experiments should be made; and he wanted to endeavour to produce oil gas in special retorts. For this purpose, he introduced into an ordinary 20-feet setting four iron retorts, each being composed of two lengths of ordinary main-pipe, into which he allowed the oil to run through syphons. These retorts were heated by an ordinary furnace—one at either end of the bend; the object being to ensure, if possible, a difference of temperature between the point where the oil entered and where it left them. By these means he was certainly able to make oil gas of an illuminating power of 40 candles from Russian refined petroleum, which was the only oil tried. A few weeks since he had the advantage of seeing in the North an oil-gas apparatus in which Scotch shale oil was employed; and on trying this at Rotherhithe (as Messrs. Ashmore and While, who manufactured it, sent him several samples), the result was that it yielded a gas of 55-candle power. But he found very great differences in the illuminating power according to the temperature. As this was raised, the lighting power rapidly fell; and the difficulties with the lampblack increased with considerable rapidity. As the iron retort approached the temperature of an ordinary fire-clay retort, the lampblack was thrown down in enormous quantities, and the ascension-pipe became stopped. He was not able to say that he experienced very good results at present from mixing this 40-candle gas with the ordinary gas; and he had been led to believe that it was undesirable to introduce the oil gas until the coal gas was entering the meter—or, at all events, it seemed to him unadvisable to pass the oil gas though more than one purifier. He was therefore somewhat surprised to hear Mr. Foulis state that the most desirable point at which to introduce the gas was in the hydraulic main. It appeared to him that the oil gas should be condensed as little as possible, and not washed at all. At present he passed it direct from the retort through a dry receiving-main, with no seal on the retorts, and through as short a line of condensing-pipes as possible direct to the exhauster, and on through a 6-inch pipe, about 70 yards long, which, of course, acted as a condenser. It went through a washing and scrubbing apparatus; and he fancied this was the reason he did not get a better result. The impurities in oil gas made from Russian refined petroleum were so slight that it was unnecessary to do more than pass the gas through one purifier, and then mix it. The greatest quantity he had made was produced from 3 to 5 gallons per hour per retort. The retorts were 24 feet long, and were nearly black at the end where the oil entered, increasing to a good cherry red at the other end. This was equal to about 75 to 80 cubic feet per gallon. But it was nothing like the 66-candle gas of which Mr. Foulis had spoken. A few weeks previously, there was an interesting article in the JOURNAL OF GAS LIGHTING [*ante*, p. 740], giving a *résumé* of the Pintsch process; and he noticed there that 40-candle gas was the highest illuminating power they claimed. He hoped to be in a position shortly, by using a small exhauster, to mix the gas at the point he indicated; and then probably a very good effect would be produced.

The PRESIDENT remarked that he should be glad to hear any gentleman present who could give the meeting any information as to the probability of a larger supply of petroleum oil to this country.

Mr. LANE said he had been connected for some time with the oil supply, and should be glad to give any information he could. The supply of oil hitherto available had been derived from sources which were suitable for producing illuminating oil for lamps; there having been two enormous fields—America and Russia. Deposits of petroleum existed in nearly every country in the world, and very largely on the Continent; but as they could not

possibly be worked to compete with the supplies in America and Russia, they had to lie dormant, and would remain undeveloped unless some suitable opening could be found for them. These oils were apparently unsuitable for direct use in gas making, as they contained a considerable quantity of either pitch or asphaltum; and apparently until these properties were removed, the present apparatus for gasifying oil, either to enrich coal gas or to manufacture carburetted water gas, was unable to deal with them. He was considerably interested in one of these fields of "Novorossisk," which had remained hitherto an undeveloped undertaking solely on account of the fact that it was impossible to work it commercially until some better opening was found for it. He had therefore been endeavouring to find some means of bringing these heavy oils into the market by arriving at an economical method of removing the pitchy or asphalte matters, and producing an article which could be used for gasification. During the last eighteen months, he had been experimenting with a considerable amount of success; and he might remark that in the next month they would arrive at a point where they could treat oil of any description, and obtain from it such a large percentage of oil that would be readily gasifiable as would render these oils commercially valuable. When this was done, gas makers could look forward to a supply of oil so large that the tendency would be rather to fall in value than to rise. The supplies of lamp-oil had increased so enormously of late that it was almost a drug in the market; and, unless production were either stopped or limited, even refined lamp-oil would be available at such a price as would enable gas makers to enrich coal gas by its means, if not to manufacture carburetted water gas. Probably this matter would be of slow development; and he did not anticipate that the demand created by the new industry was likely to affect the value of petroleum. It had been suggested that it might be practicable to utilize the crude supplies from America, if some method were adopted of removing the lighter spirituous gases, and thereby reduce the flashing-point. It appeared to him that, unless in this process of handling the oil the vapours were converted into a non-condensable gas, one would simply have a method of distillation for removing the vapoury part, such as was practised in all methods of distillation for procuring lamp-oil. The spirituous gases would pass over into the holder, where they would re-condense, and would be utterly useless for increasing the illuminating power when the gas came to be distributed. There was also the difficulty of bringing these oils to England. This could only be done by bulk-transport, which was a thing that was yet in its infancy—in fact, he was the first to introduce it. When handling crude oils which contained a large amount of spirit, the danger of importing them by tank steamers was so great as to be practically prohibitive. There were something like 60 or 70 steamers carrying lamp-oil with a flashing-point of between 70° and 86° Fahr.; and they had been engaged in the trade for three or four years without any mishap of a serious character. On the other hand, an attempt had been made to carry American crude oil containing a large amount of spirit, only five or six steamers being engaged; but three of these had already been blown to pieces—the last one quite recently. The danger was that, the spirit being flashable at zero, the oil itself flashed so close to this point that, no matter what the temperature might be, there was constant evaporation taking place. When this was going on in tank steamers, a large quantity of the spirit was evolved as soon as the tanks were emptied; and it seemed next to impossible to drive it out. The evaporation went on both from the iron and from the small quantity of oil remaining at the bottom. In this way a highly explosive compound was gradually generated; and the slightest accident or indiscretion on the part of the seamen or anyone else led to disaster. Most of the accidents had happened when the tanks were being emptied; but on one or two occasions when they were full, gas had been generated in the space allowed for expansion at the top of the cargo and below the hatch. This had escaped through some crevice not actually sealed, and had led to accident. Considering the extreme danger of the carriage of oil across the ocean, and the further danger of land carriage, they could hardly look to utilizing any oils which contained a large amount of spirit.

Mr. C. E. Botley (Hastings) said he had had considerable experience in the manufacture of both water gas and oil gas. Some twenty years ago, water gas was introduced when coal was very dear, and every attempt was made to render it successful; but this was not accomplished, though he tried many different processes. The best result arrived at, however, was with a plant of which the Lowe apparatus embodied the principles. He was rather surprised to find the quantity of carbonic acid in the gas was so small. With regard to carburetted water gas, Mr. Glasgow mentioned "oil tar" as a residual; but he (Mr. Botley) presumed that tar produced in the manufacture of oil gas pure and simple, and not of water gas, was meant. In manufacturing oil gas, he had great difficulty to know what to do with this tar, which was very explosive; but after a considerable time, he developed an idea of using it as liquid fuel for firing the steam-boilers. He accomplished this by simply blowing it with a jet of superheated steam on to a baffle of fire-bricks; the fire being lit with wood. To use it in any other way was troublesome, because it was in the form of an emulsion, with very much water and carbon grit in it. The oil-gas tar now being made in London was principally used in this way. The idea had been further developed by the Locomotive Superintendent of the Great Western Railway, who utilized it to fire the locomotive engines. With regard to the mode of enriching coal gas by oil gas, he thought the proper way was to manufacture the oil gas pure and simple, and mix it with the ordinary gas at the point where it was entering the holder. He was surprised to hear Mr. Foulis say the proper place was the hydraulic main; for if one mixed it there, the principal portion of it would be found in the tar-well, and not in the gas. Independently of that, if it were passed through the purifiers, and oxide of iron were used, the illuminating power of the oil gas would be diminished 50 per cent. The only purification necessary was to pass it through a dry scrubber, and, if thought fit, through a lime purifier; the amount of impurities being so small as to be not worth consideration. In a paper read before the Institution of Civil Engineers, he furnished the manufacturing analyses of various oils now supplied in this country; and he found the quantity of gas produced corresponded to about 76 cubic feet per gallon, and the illuminating power averaged 50 candles. One gentleman mentioned 40 candles as the quality of gas supplied for lighting railway carriages; but this was after compression. Mr. Vernon Harcourt had just suggested that the flashing-point of crude oil might be diminished by passing a stream of coal gas through it; but from experiments he had tried some years ago, his experience was that, unless the oil contained a very large proportion of light spirit, the coal gas would be diminished rather than improved in quality.

Mr. W. King (Liverpool) was largely interested in the important question of enriching coal gas, from the fact that he had to supply gas of very high illuminating power, like Mr. Foulis and others in the North and in Scotland; and the almost prohibitive price of cannel had naturally directed their attention to the question of carburetted water gas and oil gas. The result of the discussion seemed to be rather in favour of making oil gas direct, and injecting it into the stream of coal gas; thereby raising the illuminating power from 16 or 17 to the requisite 20 or 21 candles, which some of them had to supply by Act of Parliament. It was interesting to notice that the "doctors" certainly seemed to "differ" considerably; some being in favour of throwing the rich oil gas into the other gas at a point as near the retort as might be, while others who had tried it rather indicated that the two classes of gas should be kept as distinct as possible until the process of manufacture was virtually completed, and the two qualities then mixed either at the station meter or near the gasholder.

Mr. Goulden, before replying to the questions put with regard to his own paper, wished to mention that at Beckton they had for some time past been using oil in the retorts, and had found that the most successful way of introducing it was to make it in a few retorts specially fitted and mix it with the ordinary gas in the hydraulic main. He said it did not so much matter where the oil gas was mixed with the coal gas, so long as it was righly made in the first place. If it was not properly "fixed," it would come down somewhere. If it was improperly made, and then passed into the hydraulic main, it might be found in the tar-well; but if the same imperfect gas were put into the holder, it would come down into the tank. To ascertain the stability of the oil gas made at

Beckton, which was all produced from Russian oil, he analyzed a sample of the gas, a corresponding sample of which was kept for a week and subjected to a considerable lowering of temperature. The hydrocarbons absorbable by bromine in the gas when first made were 38·2 per cent.; whereas at the end of the week they were 37·6—a loss of only 0·6 per cent. So that it might be fairly assumed the gas so made was perfectly stable. Its temperature on coming from the retort was about 120° Fahr.; and it had been cooled for a considerable time to below 40° Fahr. He might note that very little carbonic acid was made—only 0·6 per cent.—and a small amount of sulphuretted hydrogen came off; while the sulphur compounds other than sulphuretted hydrogen with this oil were but 5 to 8 grains per 100 cubic feet. The cost of purifying, therefore, was insignificant. With regard to Mr. Vernon Harcourt's remarks, he would venture to suggest that the lighter parts of the oil that were carried off would be simply in the form of vapour; and on any sudden cooling taking place, they must come down. He certainly did not think they would ever arrive at the consumers' burners. If light oil could be obtained to work with, he should vastly prefer it to oil of a higher flashing-point. It was the absolute impossibility of getting such oil over here, and working with it, that was the reason it was not used. With regard to Mr. Foster's remarks on the value of mixing oil gas with coal gas, they had generally found the absolute value of a gallon of oil to be much the same when used in enriching oil gas as it was when manufactured into oil gas pure and simple. It might be assumed that the value of oil gas for improving coal gas could be calculated on the basis of testing the oil gas itself. With regard to the manufacture of water gas from crude oil in America, he might say that the amount of ash and free carbon and pitch was very much less in American than in crude Russian oil. The Lima crude oil which was most largely employed in America for gas making contained a very slight percentage indeed of those impurities; while the Novorossisk oil contained an enormous quantity, and was correspondingly difficult to work with. Where the residuum existed to the extent of only 2 or 2½ per cent., the difficulty might be overcome by working with superheating apparatus of very much larger area; but it necessitated occasional stoppages for clearing out the carbon which must be deposited in the apparatus, and a corresponding time for cooling down afterwards. With Lima oil, again, there was an amount of bisulphide of carbon evolved which came to 17½ grains more than from Russian oil. With regard to the quantity of carbonic acid, this had been analyzed very carefully, and 4 per cent. seemed to be the average—3·6 being the extreme limit.

Mr. Glasgow, at the risk of some repetition, said he would add a few words as to the crude oil referred to by Mr. F. Livesey. The apparatus explained by Mr. Goulden was only designed for the use of American crude oil, which was the cheapest that could be had in that country. It was hardly used at all for refining or lamp purposes, being too expensive. It would undoubtedly deal with a great many Russian crude oils, but not the Novorossisk, for the reasons Mr. Goulden had given. As to the ratio at which the luminosity of one gas was raised by admixture with another gas, it was undoubtedly true that a certain amount of enriching material would increase the illuminating power of one gas more than it would another. This must inevitably be so, because luminosity was a function of two elements. It depended upon the amount of carbon present, and also on the flame temperature of the gas. It was likewise true, he believed, that oil employed to enrich coal gas gave more satisfactory results than when used for enriching water gas. To a certain extent this was not material, because the oil-enriched water gas was subsequently mixed with the coal gas. It was from experiments of this kind that he drew the conclusion that, by mixing the gases together, the result in candle power was higher than it would work out on the basis of its analysis. This was due to the flame temperature of the mixture being better suited to the combustion of the oil. When making very rich water gas, the carbon present was rather in excess of the power of the flame temperature to consume; but this was not so when the mixture was made with coal gas. Mr. Botley spoke of having tried a similar apparatus some twenty years ago, and found it a failure. He (Mr. Glasgow) thought there must be some mistake as to the apparatus being similar; and it was quite natural that there should be a failure, because fifteen or even ten years ago water gas was an absolute failure in America. It was only within the past ten years that it had made great progress; and within the last four years, its growth had been a revelation to anyone connected with so conservative a thing as the gas industry. There must, he repeated, be some mistake as to the apparatus being the same, because Mr. Botley had referred to the tar, which was found to give trouble, being highly explosive; but he subsequently explained that he did not allude to the tar made from oil when it was distilled into gas before it was mixed with water gas. The whole basis of this apparatus was the simultaneous production of the gas at one operation, and the mixture; and the oil tar obtained was not at all explosive—containing 25 per cent. of water. It was, in fact, as safe to store as water.

Mr. Foulis said that the first question he would deal with was the point where the gas should be mixed; and he adhered to the statement made in the paper. In every case the gas should be subjected to the ordinary processes, and passed through the scrubber and the lime purifier in the usual way. Where there was a large quantity of poor gas and a high quality of enriching gas, it was of the utmost importance to get as thorough a mixture as possible. There was no reason why oil gas should not be made permanent; and if it was not, it was better to have it before it went into the gasholder, for it would be sure to come down somewhere. With regard to the question raised by Mr. Glasgow as to enriching ordinary gas with water gas and with oil gas, the answer depended entirely on the relative cost of the two gases. In a number of calculations he had made recently as to the value of different substances as enrichers of 16-candle gas and 22-candle carburetted water gas, it was found that, if the coal gas cost 9d., this would be equal to about 6·82d for 750 cubic feet of 16-candle, and 4·5d. for the 250 cubic feet of 22-candle gas; making the cost of the enriched gas 11·3d. But by using oil gas, the cost of the coal gas would be 8·8d., and that of the oil gas 1·2d.; so that the cost of the enriched gas would be only 10d. It entirely depended on this: They had a cheap gas which was displaced by something else; and they must take into account the quantity of gas displaced. There might be circumstances in which it would be cheaper to enrich coal gas by using carburetted water gas; but, so far as he could calculate, he thought it would be cheaper to use oil gas only. This was altogether apart from the question of what benefits might be derived from having water-gas plant in gas-works, so as to be able to make suddenly, on an emergency a large quantity of gas.

The President said they had had a very interesting discussion on the three papers. He could corroborate one statement which had been made with reference to the mixture of oil gas with ordinary coal gas. If one took 25-candle gas and 10-candle gas and added them together, theoretically only the average of the two would be obtained; but practically, in the United States, it was found that, as had been explained by Mr. Glasgow, owing to the higher flame temperature, there was a very much larger increase. Mr. Landsen, of Washington, had written a paper in which he showed that, over a series of practical workings, he obtained a very much greater increase in illuminating power than would be due simply to the mixing of the two gases.

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Mr. Charles Hunt (Birmingham) next read the following paper on

## PURIFICATION.

Since the paper which was read by Mr. Frank Livesey at the Sheffield meeting of The Gas Institute in 1883,* attention has been more than once directed to new and promising processes of purification. Much has been done to widen out the subject of purification; and it is therefore possible that something in the nature of a survey of it, however imperfect, may not at the present time appear inopportune.

It is worthy of remark, at the outset, that the London Companies appear to have entirely outgrown the aversion with which at one time they viewed the requirements of the Gas Referees as to the reduction of sulphur compounds. At this distance of time, it is not easy to understand why, apart from any question of such reduction, the advantage of lime as a comparatively cheap means

* See Journal, Vol. XLI., p. 1203.

of improving the illuminating power of gas by the removal of the carbonic acid should have been so generally disregarded. By compelling such removal, the restrictions that were so much objected to must have resulted in greater benefit to the Companies, in the shape of increased luminosity of the gas, than could be represented by the additional cost of purification.

Carbonic acid is known to be the most harmful to the illuminating power of all the incombustible diluents usually present in purified coal gas. Nearly forty years ago, Alexander Wright, following in the footsteps of Lewis Thompson, published in the JOURNAL OF GAS LIGHTING a series of experiments showing the depreciating effect of a mixture of this gas with cannel gas to be from 6 to 11 per cent. for every 1 per cent. of carbonic acid present. He pointed out, however, that by using burners more suitable for the combustion of the inferior gas, the loss might be reduced to from 3 to 7 per cent., according to the description of burner employed. In 1884, Professor Percy F. Frankland presented a paper to the Chemical Society on "The Influence of Incombustible Diluents on the Illuminating Power of Ethylene,"* which showed that the effect of a mixture of 6·32 per cent. of carbonic acid was to lower the illuminating power of the ethylene 3 per cent. for every 1 per cent. of carbonic acid. Mr. J. T. Sheard published in 1887 some experiments† showing that cannel gas, tested with an Argand burner, loses about 3 per cent. of luminosity for every 1 per cent. of carbonic acid present in the gas.

Just twenty years ago the author, who was then at the Nine Elms Gas-Works, made a number of experiments upon this subject, some of which it may be useful to quote. The gas used varied in quality from a little more than 12 to about 30 candles, and was made with mixtures of coal and cannel, so as to vary the percentages of carbonic acid. On its way to the photometer, the gas was passed through two experimental meters, between which was placed a small dry lime purifier. Attached to the purifier was a bye-pass, and the gas was made to flow alternately through the bye-pass and the purifier. The index of each meter being taken at the beginning and end of each experiment, the difference in registration was arrived at, and also the difference arising from the absorption of carbonic acid by the lime. The following are the results arrived at with common gas, tested by the then Parliamentary Argand:—

| $CO_2$ in Gas, per Cent. | Illuminating Power per 5 Cubic Feet Consumption. | | Increase of Illuminating Power. | | Increase per Cent. for every 1 per Cent. $CO_2$ removed. |
|---|---|---|---|---|---|
| | With $CO_2$. | Without $CO_2$. | Candles. | Per Cent. | |
| 7·6 | 14·04 | 17·34 | 3·30 | 23·5 | 3·1 |
| 5·2 | 14·08 | 16·04 | 1·96 | 13·9 | 2·7 |
| 3·8 | 14·62 | 16·23 | 1·61 | 11·0 | 2·9 |
| 6·5 | 11·17 | 13·75 | 2·58 | 23·1 | 3·5 |
| 2·7 | 12·21 | 13·16 | 0·95 | 7·8 | 2·9 |

Average increase per cent. for every 1 per cent. of $CO_2$ removed, 3.

The following are particulars of an experiment made recently under the direction of the author:—

| — | Candles. | Percentage of $CO_2$. | Height of Flame in Chimney. |
|---|---|---|---|
| | | | Inches. |
| Illuminating power of gas per 5 cubic feet consumption, tested with a No. 1 standard Argand burner, 6 in. by 2 in. chimney, and Methven's screen . . . . | 16·6 | 1·36 | 3¾ |
| Do., after passing through experimental lime purifier. . . . . | 17·2 | 0·04 | 3¾ |

These figures show for 1 per cent. of carbonic acid a loss of luminosity of 2·6 per cent.; or, on the basis of a normal production of 10,000 cubic feet per ton, a reduction of 1·67 per cent. in value for 1 per cent. of carbonic acid. Thus:

| | |
|---|---|
| 10,000 × 17·2 candles . . . . . | = 172,000 |
| 10,000 + 1·32 per cent. $CO_2$ × 16·6 . . | = 168,191 |
| Difference . . . . . | 3,809 |

or 2·2 per cent., which, divided by 1·32, equals 1·67 per cent. for 1 per cent. of carbonic acid. For small percentages of carbonic acid, this figure is probably the lowest on record. It indicates, however, an adverse effect of nearly, if not quite half a candle, upon common gas, from the presence of from 1½ to 2 per cent. of carbonic acid.

The cost of enriching gas to the extent of one candle only by means of cannel has recently been stated by Mr. Frank Livesey to be 2·68d. per 1000 cubic feet made. Field's "Analysis"* for 1889 gives the average cost of purification to the three London Companies as 0·76d. per 1000 cubic feet sold.

No system of purification can fully satisfy the economic instinct which does not provide for the elimination, in a saleable form, of such impurities as possess a market value. Economy may, however, be justifiably assigned a second place by the attainment of greater security and efficiency. The first object is to effect purification, by which is meant compliance with the London standard; and the next, to do the work as cheaply as possible.

In this view, the two chief methods of dry purification in present use appear to be in competition for survival. One of these may be described as that in which a different material is employed for each impurity, generally, though not always, in separate vessels; the other, in which lime is either the sole material or else supplemented, as a measure of precaution, by oxide of iron or other suitable material in check or catch purifiers.

With the first method, seldom fewer than eight, sometimes as many as ten, purifiers are used. The impurities being attacked separately, the cost of removing each of them may be accurately ascertained; and the only one of present value—sulphur—becomes a saleable product. As a set-off to these advantages must be considered a somewhat large capital outlay, with corresponding occupation of ground space, and an apparent complication of arrangements, requiring great watchfulness to prevent irregularity in the reduction of sulphur compounds. Moreover, at the present time, the production of spent oxide is generally unremunerative.

The second, and by much the older, method involves the use of only four purifiers—three at work and one off—although two catch-vessels are sometimes added. A somewhat greater area per purifier would seem, however, to be needed than in the first method, because the whole of the impurities are dealt with in the same vessel.

Lime being the sole material used, the quantity required must, under ordinary conditions, correspond not only with the carbonic acid to be removed, but with the sulphuretted hydrogen in addition. It would seem, therefore, that the all-lime method cannot possibly compare favourably, in the matter of economy, with the lime and oxide; while the continual displacement of sulphuretted hydrogen from its combination with the lime by the carbonic acid as it advances, causes the removal of the sulphur compounds to be somewhat uncertain. This objection is to be overcome by changing the purifiers according to the quantity of sulphur compounds coming forward; but only, as would seem, at the cost of additional lime. The liability to nuisance from the foul lime is also an objection to this method. If, however, a little air or pure oxygen be added to the gas, these difficulties are found to largely, if not wholly, disappear. A certain amount of free sulphur is deposited in the lime, and a portion is oxidized as sulphites. The chemical reactions which occur appear to be imperfectly understood. The spent lime is, however, rendered practically inodorous; and, owing perhaps in some measure to the greater heat evolved by the increased chemical action within the purifiers, the sulphur compounds are reduced with constancy and regularity.

Air used with oxide of iron is a very old expedient; and it should be reassuring to the popular sentiment with regard to it to know, upon the authority of Professor Frankland, that it is the least prejudicial to the illuminating power of all the diluents which are incidental to the manufacture of coal gas; its effect being almost proportional to the quantity present. Practically, therefore, no depreciation of value results from the mixture. This not unfavourable influence is probably due in some measure to the oxygen contained by the air; a mixture of oxygen having been found, especially in the case of a very rich gas, to assist luminous development. In the purifiers, however, the oxygen is either wholly or partially withdrawn; and hence, when applied in the form of atmospheric air, it is the effect of the nitrogen that remains which has to be reckoned with.

* See JOURNAL, Vol. XLIV., p. 17.
† *Ibid.*, Vol. L., pp. 240, 493, 532, 670.

* See paper read before the Southern District Association of Gas Engineers and Managers, JOURNAL, Vol. LVI., p. 1041.

The experiments made by Professor Frankland, already referred to, showed that mixtures of nitrogen with ethylene varying from about 15 to 71 per cent., reduced the illuminating power of the ethylene from 1·57 to 1·25 per cent. for every 1 per cent. of nitrogen added; the least proportionate depreciation taking place with the highest percentage of nitrogen. Taking into account, however, the increase of volume from the added nitrogen, the actual depreciation of value is considerably less than would be indicated by these figures. Thus, while with 15·36 per cent. of nitrogen added, the loss of luminosity is shown to be 1·57 per cent. for every 1 per cent. of nitrogen, the actual depreciation of value works out at only 0·81 per cent. This means about 0·13 of a candle for common or 16-candle gas.

The following particulars of experiments upon a working scale with air and oxide of iron purification have been kindly placed at the disposal of the author. They bear evidence of having been conducted with the greatest care and accuracy.

| —— | No. | Total Gas made. | Gas made per Ton. | Illuminating Power. | No. of Tests of Illuminating Power. | Percentage of Cannel used. | Percentage of Air admitted. | Value. Gas made per Ton × Illuminating Power. | Diminution in Value by Admission of Air. | | Diminution in Value per Cent. by 1 per Cent. of Air. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Multiple. | Per Cent. | |
| | | Cubic Feet. | Cubic Feet. | Candles. | | | | | | | |
| Same mixture of coal | 1 | 852,000 | 10,923 | 22·19 | 75 | 50·0 | .. | 242,381 | .. | .. | .. |
| | 2 | 642,000 | 10,940 | 21·92 | 53 | .. | 0·75 | 239,804 | 2577 | 1·06 | 1·4 |
| | 3 | 657,000 | 11,239 | 21·42 | 47 | .. | 1·61 | 240,739 | 1642 | 0·67 | 0·4 |
| | 4 | 750,000 | 10,989 | 21·53 | 49 | .. | 2·86 | 236,593 | 5788 | 2·38 | 0·8 |
| Do. | 5A | 283,000 | 10,884 | 22·97 | 16 | 57·7 | .. | 250,005 | .. | .. | .. |
| | 5B | 294,000 | 11,308 | 22·01 | .. | .. | 3·44 | 248,889 | 1116 | 0·44 | 0·1 |
| Do. | 6A | 281,000 | 10,807 | 22·94 | .. | 53·8 | .. | 247,912 | .. | .. | .. |
| | 6B | 284,000 | 10,923 | 22·45 | .. | .. | 1·58 | 245,221 | 2691 | 1·08 | 0·6 |
| Do. | 7A | 284,000 | 10,923 | 23·60 | .. | 60·0 | .. | 257,783 | .. | .. | .. |
| | 7B | 295,000 | 11,345 | 22·26 | .. | .. | 4·86 | 252,540 | 5243 | 2·03 | 0·4 |

Average diminution in value per cent. by 1 per cent. of air, 0·5.

The smaller amount of depreciation which is shown with the highest percentages of air may be partly accounted for by the presence of oxygen in the outlet gas. Oxygen is, for some reason, less active with oxide than with lime. Traces of it may be found at the outlet of oxide purifiers, at the same time that none can be detected at the outlet of lime purifiers, although entering both sets of purifiers in the same proportion.

Experiments made upon the lines of those which have just been quoted ought not to yield very discordant results; yet it has to be admitted that considerable diversity of opinion exists as to the proportion of air which may be mixed with the gas without appreciable loss of illuminating power. Some think that from 3 to 4 per cent. may be so employed; but the greater number draw the line at about 1 per cent. On the other hand, Mr. Valon has found that, with mixtures of 2½ per cent. and upwards, every 1 per cent. of air reduces the illuminating power by fully 7 or 8 per cent.

It would be a difficult task to seek to reconcile such very great differences; but it may be of some assistance to point out at least one probable source of error, either unsuspected or disregarded. This is in the accepted method of testing with what is known as the standard burner. It is many years since the author first drew attention, in the JOURNAL OF GAS LIGHTING, to the variable results yielded by this and other burners with the same gas, at different rates of consumption. The subject afterwards engaged the attention of the then Gas Referees; but quite recently a pronouncement of considerable importance has been made by no less an authority than Mr. A. V. Harcourt, a present Gas Referee. While discussing Mr. Methven's paper on "Photometry," read last year before the Southern District Association of Gas Engineers and Managers,* Mr. Harcourt said: "With the London Argand, if the consumption were reduced by one-fifth, the yield of light sank to about one-half; and, from the same causes, if the actual quality of the gas were somewhat low, the yield of light with a consumption limited to 5 cubic feet per hour was greatly reduced. Thus any deficiency in the gas was much exaggerated. A more just estimate would be found by setting the light of the burner equal to 16 candles, and observing the rate of consumption."

* See JOURNAL, Vol. LIV., pp. 968, 1011; and Vol. LV., p. 336.

This puts the case in a nutshell. It is clear that startling results obtained by adhering to the prescribed rate of consumption can possess no claim to scientific accuracy, and are, indeed, likely to be greatly misleading, as the candle value becomes disturbed. A candle loss does not mean that of a real candle, except under conditions which are rarely met with outside the photometer-room. It is doubtless true that the gas maker must stand or fall by his standard burner and prescribed rate of consumption; but he has at least the satisfaction of knowing that the practical measure of any loss indicated by the present unscientific method of testing is not the observed effect, but that which is required to compensate for it. Thus where, as mentioned by Mr. Harcourt, the light is diminished by about one-half from a reduction in the consumption of one-fifth, it requires, not double the consumption, but only one-fourth more, to produce the same amount of light as before. Similarly, the quantity of light-giving material required to restore to its original luminosity the adulterated gas experimented upon by Mr. Valon, should be, not Mr. Valon's 7 or 8 per cent. for every 1 per cent. of air, but rather Professor Frankland's 1 per cent., or, upon the basis of nitrogen depreciation, from 1¼ to 1½ per cent.

It cannot be correct to charge the gas with the imperfections of the burner. In all investigations of this kind, the rule should be to adjust the consumption to the point of economic combustion. The effect of this is seen in the following experiment, where the depreciation in luminosity proved to be only 1·4 per cent., as against 4·6 per cent. at the prescribed rate of consumption:—

| Description. | Tests made with a Consumption of 5 Cubic Feet of Gas per Hour. | | | Tests made with Chimney full of Flame; the Illuminating Power calculated on a Consumption of 5 Cubic Feet of Gas per Hour. | | |
|---|---|---|---|---|---|---|
| | Illuminating Power. | Loss of Illuminating Power. | | Illuminating Power. | Loss of Illuminating Power. | |
| | Candles. | Candles. | Per Cent. | Candles. | Candles. | Per Cent. |
| Gas . . . . | 50·70 | .. | .. | 16·33 | .. | .. |
| Mixture of 90 per cent. of the gas and 1 per cent. of air . | 14·97 | 0·73 | 4·6 | 16·10 | 0·23 | 1·4 |

*Illuminating Power of Gas Tested under Different Conditions.*

| Chimney. | Consumption per Hour. | Illuminating Power calculated on a Consumption of 5 Cubic Feet of Gas. |
|---|---|---|
| In. In. | Cubic Feet. | Candles. |
| 7 × 2 | 5·00 | 13·72 |
| 6 × 2 | 5·00 | 15·75 |
| 6 × 1¾ | 5·00 | 16·08 |
| 7 × 2 full of flame | 6·93 | 16·91 |
| 6 × 2 full of flame | 6·10 | 16·97 |
| 6 × 1¾ full of flame | 5·73 | 17·04 |

With a consumption of 5·02 cubic feet per hour (standard temperature and pressure), the gas tested 16 candles in a 6-in. by 2-in. chimney; therefore 15·93 candles for 5 cubic feet per hour.

The foregoing experiment also shows what is, in most cases, the point of economic combustion, and at the same time how greatly, with the same gas, the results may be made to vary with the same burner. The best effect, in this instance, was obtained when the flame fairly filled the chimney, without smoking or tailing over; and in this condition the gas showed little variation with any of the

three chimneys. Occasionally, however, a gas may be met with which yields a better result with a shorter flame than this.

Pure oxygen, as a substitute for air, has found an able advocate in Mr. Valon; and there must be a common agreement of opinion as to its superiority, owing to the absence of nitrogen. On this account alone, it is entitled to rank high as a purifying agent, because it enables economy of material to be pushed to the utmost limit without injury to the gas. In conjunction with lime, it is said, the quantity of the latter for complete purification of the gas may be reduced to almost that which is required for the removal of the carbonic acid alone. This should result in the further advantage of a corresponding reduction of purifying area. In other respects, however, those who have had experience with air can hardly fail to recognize in its effect an almost perfect similarity to that of oxygen. There is the same chemical activity, as indicated by the temperature of the purifiers; the same saving of lime in proportion to the oxygen employed; the same absence of odour in the foul lime; and last (though not least) the same, or practically the same, reduction of sulphur compounds.

The depreciating effect of nitrogen has already been mentioned as amounting, in the case of 16-candle gas, to about 0·25 of a candle for every 1 per cent. of dilution—representing about 0·13 of a candle loss in value; and this is the amount of the bill which, in some way or other, has to be paid when air is used. It is conceivable that so small a loss may, under some circumstances, be unperceived, and when otherwise it should not be difficult to compensate for it by a slight alteration in the method of working. When, also, the air and lime process is substituted for one in which the carbonic acid is only imperfectly extracted, the loss resulting from the added nitrogen may be fully or more than made up by the gain derived from the complete removal of the carbonic acid, the depreciating effect of which is nearly double that of nitrogen, and fully two and a half times that of air. Except under restrictions as to the removal of sulphur compounds, it is rarely that carbonic acid is reduced below 0·50 or 0·75 per cent., the removal of which would quite compensate for the addition of from 1 to 1·5 per cent of nitrogen.

For complete purification, however, and bearing in mind that the less air the more lime, omitting also the lime required for the removal of carbonic acid, which is common to all methods, the comparison as to cost is either between oxide of iron and calcium sulphide (or sulphydrate) purification, or lime sufficient to remove both the sulphuretted hydrogen and the sulphur compounds, on the one hand, and oxygen (with credit for reduction of purifying area) on the other; or between the latter and any means by which the loss of luminosity caused by the dilution with nitrogen from the air may be made up, credit being taken for the metered nitrogen.

The quantity of material required for purification necessarily varies with the amount of impurities to be removed. On a basis of 70 per cent. of caustic lime being used up, the theoretical quantity required to remove an average of 2 per cent. by volume of carbonic acid, or 1629 grains per 100 cubic feet, would be 2·96 cubic yards per million cubic feet of gas purified. For the removal of 1·25 per cent. by volume of sulphuretted hydrogen, or 786 grains per 100 cubic feet, on the supposition that the ratio of sulphur to calcium in the spent lime is as 1 : 1·25, a further quantity of 1·83 cubic yards per million cubic feet of gas purified would be required; making 4·79 yards in all. Only the lesser of these two quantities can, of course, be affected by the use of oxide of iron, air, or pure oxygen.

Some difference of opinion exists as to what purifying area is necessary. It is generally found that a large area is conducive to economy of purifying material, as shown by the greater proportionate duration of the purifiers in the period of least production. This, however, may be owing in some measure to a smaller quantity of impurities. When, as in winter, a large proportion of stacked coal is used, the quantity of impurities may be greatly increased. In the author's experience, the percentage of carbonic acid alone has risen, apparently from this cause, to 2·6, from a normal 1·4 to 1·8.

In determining the area of purifiers, the chief points to consider are back pressure and the maximum quantity of impurities—viz., carbonic acid and sulphuretted hydrogen—at the period of the greatest make. It is undesirable to work with a greater back pressure than (say) 20 inches in all, of which one-third to one-half may be represented by the purifiers, although not unfrequently this is greatly exceeded. With oxide of iron the resistance is much less than with lime, when it follows the former, and is used for taking out carbonic acid; the lime having a tendency to harden when carbonated. Sulphuretted hydrogen, however, seems to keep the lime open; so that, with regard to back-pressure, the all-lime process may be said to rank with oxide of iron.

If the maximum quantity of impurities and quality of material are ascertainable with any degree of accuracy, these should enable the duration of a purifier to be calculated with tolerable certainty; and, after all, the question of purifying area is to a great extent one of how long the purifiers will last during the period of greatest make. With oxide of iron, such a method of determining area is probably of little value, because of the varying efficiency of the material according to its quality and the quantity of sulphur it has taken up. The quality of lime is, however, practically unvarying from one period to another; and with it such a method should not present much difficulty if the ratio of sulphur to calcium in the spent lime be ascertainable.

As to what may be the most convenient interval to elapse between a change of purifiers, opinions will probably be found to differ almost as much as circumstances. So long, however, as a purifier is not too large to be emptied and re-charged without strain within the limits of an ordinary working day, a minimum interval between the charges of from two to two and a half days would appear to be sufficient. This is much greater than is often the case when oxide of iron is used.

If this view be correct, one effect of the use of air or oxygen should be a reduction of the area of each purifier, because the same amount of material is made to do more work. This point, however, in favour of these processes, has not yet been fully established; and it is not improbable that a reduction of area proportionate to the saving of material might, in many cases, result in forcing up the back pressure beyond the limits of convenience or safety.

The use of pure oxygen as a means for increasing the luminosity of coal gas does not properly belong to the subject of purification; but, having become somewhat prominently associated with the latter, a brief reference to it may not seem out of place. No apology should be needed for once again referring to the authoritative experiments of Professor Frankland, which show the greatest effect produced by oxygen as a diluent to be an increase in luminosity of the mixture, as compared with ethylene alone, of just 0·33 per cent., or an actual increase of value of 1·5 per cent. for every 1 per cent. of oxygen added. Contrasted with this infinitesimal result, the claim advanced on behalf of oxygen as an enricher would appear to be, and probably is, wholly untenable. More than one cause may be at work to deceive an observer; and the results showing increased luminosity due to oxygen may (in part at any rate) be attributable to the exaggeration of the standard burner. This is not confined to the "down grade" of consumption in quality, but extends upwards also, until the point of utmost economy is reached. It is as well also to bear in mind that oxygen is not an illuminant, but merely a supporter of combustion. As such, it can do little more than supplement the effort of the burner. Oxygen cannot be said to increase the intrinsic value of coal gas for either heating or lighting purposes, in the same way as is effected by adding hydrocarbons derived from cannel or oil.

So long as the recovery of sulphur from waste lime continues to be unremunerative, it would appear that, although more costly for labour and purifying area, the oxide and lime must be the most economical system of dry purification, because only by it can the sulphur be brought to market. On the other hand, the all-lime system is by far the simplest, and perhaps the most reliable. Supplemented by a supply of cheap oxygen, the gas manager who uses it ought to be a happy man. But will he—or, indeed, ought he to—be so, as long as there is a possibility of effecting complete purification without either lime or oxide, or extraneous assistance of any kind, and with the recovery of sulphur in a more valuable form than the familiar one of spent oxide. Such a prospect was opened

out, not wholly for the first time, but for the first time in a complete form, by the experiments made a few years ago at the Windsor Street gas-works of the Birmingham Corporation, with the Claus process of ammonia purifying.* These experiments have since been repeated on a much larger scale at Belfast; and it is greatly to be hoped that Mr. Stelfox may shortly be in a position to communicate to the members of this Institution the results of his valuable and interesting experience. Whatever these results may prove to be—whether favourable or otherwise—it is hardly probable that the last word will have been said upon a subject of so much economic and scientific importance.

*Discussion.*

Dr. C. W. Heaton, in response to an invitation from the President, said he could not at present lay before the meeting any important information with regard to the Claus method of purifying coal gas. There was an interesting story to be told with regard to the Belfast experiment. But it would be premature to speak of it now; and he would much rather, if possible, that the first information should come from Mr. Stelfox, who had had the care of the matter all through. He might say, however, that many of the mechanical difficulties with which they had been contending there seemed in a fair way to be removed; and during his last visit, he found absolute purification was being effected by ammonia only.

Mr. Iago (London) said he had had some experience of the air process, and would venture the opinion that it did not depreciate the value of gas to such an extent as was usually supposed. He had not found any necessity, generally speaking, with ordinary coal, to use any cannel, even where he was employing a large proportion of air for purification purposes. He thought where 2½ or 2¾ per cent. of air was used, that was very excessive; but he should like gentlemen to bear in mind that this represented the total quantity of air in the gas. He had tested gas where the air process was not in use, and had found 2 per cent. of air introduced through leakages or from the drying of the hydraulic main; so that from 2½ to 2¾ per cent. of air compared very favourably with the proportion of oxygen that Mr. Valon described as being necessary for complete purification by the Brin process. An experiment could easily be tried to ascertain the percentage of air in gas; and it would often be found that the quantity that they were obliged to add would bring the total up to nearly the point he found requisite. He believed in the air process, and failed to see at present any need for oxygen taking its place. There was a certain saving claimed on account of the smaller purifying area needed; but he did not think this was conclusively proved. The area wanted for the air apparatus was greater than he required for the sulphide boxes; but in stations in towns the nuisance from sulphides made it almost a necessity to adopt some other process.

Mr. A. C. M'Minn (London) said that, in conjunction with his brother, Mr. T. M'Minn, he originated the air process of sulphur purification many years ago at Fulham, though long before the sulphur restrictions were imposed, air, introduced at the hydraulic main, had been used by Mr. T. N. Kirkham, in order to make the oxide purifiers last longer without changing. When they were bound to supply gas of a certain purity as regards sulphur compounds, they had become so accustomed to the use of air that it was looked upon as a matter of course; and it was not until very serious trouble arose with the sulphur purification, and he was led to make experiments and analyze the gas at the outlet of the purifiers (finding very remarkable results), that he was convinced that the introduction of air with the gas had something to do with the difficulty. The matter was then very closely investigated by himself and his brother conjointly; and it was found that, by properly regulating the supply of air, a perfectly reliable method of purification from sulphur was obtained, allowing of the ordinary rotation method of working their purifiers (three on and one off), and without the use of separate sulphide vessels—the spent lime coming out in a comparatively inoffensive condition. He felt uncertain himself as to whether or not sulphur purification could be successfully conducted with the use of the amount of oxygen which had, he understood, been mentioned—viz., sufficient to deal with the whole of the sulphuretted hydrogen, and leave a certain amount of free oxygen in the gas to go forward and increase the illuminating power at the burner, as had been stated. Judging from his own experience with the air process, this would upset the sulphur purification, as too much oxygen caused trouble as well as too little. One might successfully conduct purification without the special admission of air for a time, on the ordinary rotation system. It was a question of the proportion of the sulphuretted hydrogen to the carbonic acid. If the proportions were such as not to form acid sulphides in the purifiers, it would go on for weeks; but if, from a change of coal or other cause, the proportion of this impurity were increased, then acid salts would be formed, and the sulphur would go up by leaps and bounds. This arose from an excess of sulphuretted hydrogen; and it would be brought down again in three or four hours by the introduction of air, as he had found on more than one occasion, reducing the sulphur from 40 or 50 grains to 10 or 12 grains. If, on the other hand, the proportion of sulphuretted hydrogen were too small, or too much air were admitted, the amount of sulphur would fluctuate, the rise would be more gradual, and the shutting off of the air would not bring matters right anything like so quickly as its admission in the former case. It was not to be understood that these difficulties arose in the air process when properly conducted. They were merely cited as instances to show the action of the air, and to prove that there was a limit to the amount of oxygen that could be used. Apart from the question of illuminating power, he did not see any difference between the action of air and that of oxygen in the purification of gas; but if oxygen could be obtained as cheaply and with as little trouble as air, it would be the more preferable of the two. He agreed with what Mr. Hunt had said about the decrease in illuminating power resulting from the introduction of a small percentage of air not being so great as was generally believed. He thought a good deal depended upon where it was let in. He allowed it to be drawn in at the tar extractors, where the gas was hot from the hydraulic main, before condensation; and he believed that the nitrogen acted to a certain extent as a carrier of hydrocarbons. As a rule, he did not measure the amount of air introduced at all. It was simply regulated by a 2-inch pipe, having a number of rings of small holes in it, provided with a long screw-cap, which could be so regulated as to cover or uncover the rings of holes as was found necessary. When he had measured the quantity of air, he found it was about 1 per cent.; and in his case 2½ per cent. could not be introduced continuously without appreciably decreasing the illuminating power.

Mr. Lacey (London) said the question of the quantity of air to be used in this process was very important; and if the actual percentage of oxygen required could be arrived at, it would be very valuable. Mr. Iago said he had every reason to believe that he had very little oxygen in from any other source than that actually measured; but this was probably because he had a slight pressure on the whole apparatus. Wherever there was a vacuum, it was generally the case that it was impossible to be quite certain that the apparatus was air-tight. Then the question arose, not what was the quantity of oxygen, but how much nitrogen there was in the gas; and the best way to settle this was to find out how much nitrogen people using the specified quantities of air had in their gas. They might find 1½ per cent of nitrogen where Mr. Valon's system was used; while in other places, with air, it might be 2 and 2½ per cent. If they could actually arrive at the amount of nitrogen under different systems—where air was accidentally admitted and where oxygen was used—it would do a great deal to clear up the point of the effect of introducing nitrogen. The experience of people who employed air with the ordinary dip was that it should not exceed 1½ per cent.; and he thought that about 1 per cent. was the average. The amount of nitrogen used by most people under ordinary conditions would not be more than 1 per cent.; and when there was 2 per cent. already in the gas, he did not think it would make such an important difference in the illuminating power as some people believed. The estimation of oxygen was perhaps a difficult thing to do; but he had tried a process that was not generally known, which was very convenient as an approximate method—viz., the Harcourt test, with a solution of pyrogallic acid and potash as a colour test. Taking extreme

*An account of these experiments will be found in the Journal, Vol. XLVII., p. 1181.

precautions to prevent the presence of oxygen in the reagent, the solution was perfectly colourless when there was no oxygen; and if there were any trace the quantity could be estimated. One interesting point about the Brin process was as to what became of the carbonic acid when it reached the purifiers; because if it converted the lime into ordinary carbonate of lime, the result would be most disastrous. The effect must be that the sulphur compounds formed would be gradually acted upon in such a way that the carbonic acid was no longer able to turn it out. There was never so large an amount of sulphur compounds in these vessels, because they were changed more frequently than ordinary lime vessels. Still the carbonic acid had to come into contact with the compounds; and it seemed that it must be a different compound at the time when the carbonic acid reached it to what it was when the sulphur vessels were employed in the ordinary way. As far as the actual composition of the compounds formed by sulphide of carbon and sulphide of lime was concerned, he did not think their knowledge was very much farther advanced than it was some years ago. Attention had recently been drawn by Dr. Hood to the peculiar effect of bisulphide of carbon on the ammonia in gas. It was well known to some people that bisulphide of carbon and ammonia would re-act on one another, as was stated in Watts's Dictionary; but the practical application of it was rather neglected. They were allowed to have a certain amount of ammonia and bisulphide of carbon, and the gas might leave the works perfectly clear, with no trace of sulphuretted hydrogen; but, under certain conditions, these bodies would re-act, and produce sulphuretted hydrogen in another place. Therefore, gas containing traces of ammonia might at some time or another develop sulphuretted hydrogen, even in the process of being tested. The quantity of sulphuretted hydrogen produced was, no doubt, microscopically small, when tested with lead paper; but now that they had Mr. Vernon Harcourt's test, he thought it was high time that this impurity should be estimated quantitatively, and they should be allowed a reasonable quantity—say, up to 1 grain per 100 cubic feet—and not be called to account unless the gas exceeded it. They should not be fined for traces of sulphuretted hydrogen, which made no difference to the consumer, but were a great annoyance to the manager who supplied gas entirely free from this impurity when it left the works.

Mr. A. Colson (Leicester) said the experience of the author on one point was much at variance with his own. Mr. Hunt said, with regard to back pressure, "the all-lime process may be said to rank with oxide of iron." That was not his (Mr. Colson's) experience. He found the back-pressure on all-lime boxes double, and sometimes three times, as much as that arising from oxide of iron. He should like to know the experience of other engineers, because back-pressure in connection with gas purification was of the utmost importance. Another point was the extent to which back-pressure varied in the same boxes from time to time. For instance, sometimes he would get a lime box which would throw one to two inches; and at another time—with lime of precisely the same quality, mixed in exactly the same way—it would be two or three times as much, and the cause he had never been able satisfactorily to account for. He had never been able to work with more than 1 per cent. of air without reducing the illuminating power; but to that extent he worked for some time, with considerable benefit to the purifiers, and without any reduction of the illuminating power. He could not agree with the last speaker as to any latitude being permitted in respect of the sulphuretted hydrogen allowed to be left in the gas. He did not think such an arrangement would be satisfactory either to themselves or to the public.

Mr. W. Foulis (Glasgow) said at his works they used nothing but lime. He found that the pressure produced depended very much on the length of time the lime had been left after being slaked. Unless the lime was thoroughly hydrated, and quite cold, the back-pressure would certainly rise. He had a case only last winter where every day reports came in that the purifiers were blowing; and, on examination, it was found that the lime was rather new. He at once obtained a fresh supply of lime, which was slaked, and quite cool; and the moment the cold lime went into the purifiers, the pressure came back to the normal, and they had no more difficulty.

The President said, in connection with the use of lime, there was a gentleman in the room who was anxious to bring before the meeting a plan he had devised for the re-burning of lime.

Mr. Stokes then described, with the aid of a large diagram, a plant he had devised for re-burning foul lime. By the Hislop process, he said, the time occupied was about six hours; and it occurred to him that this was unnecessary, seeing that under favourable conditions carbonic acid could be driven off chalk in a very much shorter space of time—supposing always that the atmosphere was suitable, and its elimination was provided for. He, therefore, made a series of experiments with pieces of chalk about $\frac{1}{8}$ inch thick; and he found that in five minutes there was no trace of carbonic acid in them. With pieces $\frac{1}{2}$ inch thick, it required 20 minutes; and with 1-inch cubes, 55 minutes—this was to decarbonate them. This showed clearly that the size of the pieces of chalk was a very important element. There were, therefore, these elements necessary for the quick treatment of spent lime—viz., the rapid carrying off of the carbonic acid given off, and the smallness of the piece of lime. Luckily in spent lime the pieces were very much smaller and granular; and it occurred to him that a simple revolving furnace would be the most suitable arrangement for bringing about the rapid application of heat, also the frequent turning over of the lime and the exposure of each particle to the atmosphere, which in this case was only charged with about 13 per cent. of carbonic acid. The diagram on the wall showed that the spent lime was tipped into the upper end of a revolving furnace—on an incline as it revolved; the material slowly flowing to the other end, where gas from a producer was admitted, and combustion took place. At each revolution, the particles were turned over and over; each particle being exposed to the top surface three times every revolution. Thus, by the time it reached the other end, it was completely decarbonated, and fell through a zig-zag passage, so as to be carried away by the incoming draught into a reversing furnace, in which the cooling operation took place. The air for combustion entered through this revolver; and on its way picked up the heat from the burnt lime, so as to become heated, and allow for a great access of air being admitted into the furnace. Ample means were afforded for carrying off the carbonic acid. Trucks could be brought up under the end of the cooler, into which the re-burnt lime could be filled, and taken to a convenient place for slaking. With coal at 5d. per cwt., and wages at 8d. an hour, he found that the expense of re-burning the lime (taking wet lime) came out at 2s. 8d. per ton. He also mentioned that, supposing the chalk in the first instance was reduced to small pieces, this furnace would be most suitable for the burning of lime. In such a case, the lime would be obtained free from slack. At present he had only made experiments on a very small scale. But they were most promising; and he hoped at some future time to lay further facts before the Institution.

Dr. Thorne said he had been much interested in this question of purification by means of pure oxygen. He regretted that the two gentlemen who had had the most lengthened experience with this process, Mr. Valon and Mr. Belton, of Shrewsbury, were not present to speak on the subject. He had just received letters from both of them, however, giving a few details which might be interesting. Mr. Valon said, having completed a year's working, he was able to give particulars; and he thought that during the past year they had been making about 400 cubic feet more gas per ton of coal carbonized than before, and that the resulting gas had had an increased illuminating power of 2 candles over the previous year, when they were using 22 per cent. of cannel with oxide of iron only, and 1 per cent. of air. Last year they used no cannel at all. He had intended to enlarge his purifiers; but it had not been found necessary. They had now four purifiers 14 feet square; the lime having been used at the rate of one ton per million feet of gas made. With regard to this figure, he (Dr. Thorne) might mention that the crude gas there contained a much larger percentage of carbonic acid than in many other cases—speaking from memory, about $\frac{3}{4}$ per cent. more. The sulphuretted hydrogen in the crude gas was 600 grains; sulphur in other forms, 40 grains; in the purified gas, it averaged 10·2 grains. The illuminating power averaged through the year 16·8 candles; while last year it was 15·4 candles.

As to the cost of oxygen, Mr. Valon said he was not able to speak of this with certainty, because he had not had the process long enough in action to know definitely the wear and tear. But he had not had to renew any retorts; and he thought 2s. 9d. per 1000 cubic feet would cover the whole cost. With an increase of 12 million cubic feet over last year's make—the total this year being 133 millions—the cost of his labour for purification had been less than half what it was the previous year. Mr. Belton wrote that they had been in the habit of using, continuously, 10 to 11 per cent. of Nottinghamshire cannel before they used the oxygen; and the figures he gave had an extra interest, because he was employing lime purification only before he introduced the oxygen. He did so mainly for the purpose of obtaining freedom from smell, which he had before found a great difficulty. It had enabled him to do away with cannel, excepting in the very cold weather; and without any cannel he was now getting (employing a North Wales coal, which was a little inferior to what he used previously) practically the same illuminating power as before, or an increase of 1¼ to 1½ candles. Turning to the paper, there were, said Dr. Thorne, one or two points he should like information upon. It was not quite clear to him, from the experiments mentioned in the early part, as to the illuminating power of gas for 5 cubic feet consumption, whether this 5 feet was taken from the meter before or after the purifier; although he should imagine that it was taken after. Then it was stated to have been determined with the "Methven screen." In all these determinations, they must be very careful in the use of this screen. Mr. Hunt said his flame in the instance containing a large percentage of carbonic acid was 3¾ inches high; but where it contained no carbonic acid, 3½ inches. In other words, every portion of the flame must have been more highly illuminating. The illuminating surface was smaller; but the total effect was larger. It seemed to him (Dr. Thorne) that it followed from this statement, that the unit of surface taken by the Methven screen was giving out more light in the determination made by the gas free from carbonic acid than it was in the gas containing carbonic acid; so that the 17·2-candle gas was really taken with a higher standard, and should have come out much higher.

Mr. Hunt explained that the standard by which the illuminating power was determined was the same throughout; being taken by an independent supply of gas. It was not the gas being experimented upon.

Dr. Thorne went on to say that Professor Frankland's experiments seemed to him to show very clearly the actual detrimental effect of nitrogen compared with the effect of the oxygen, if they did not take the somewhat fallacious numbers given in the readings. But taking the actual illuminating power of the ethylene, his tables showed that, in the case of oxygen, this power was actually increased from 70 to 104 candles by the introduction of 30 per cent. of oxygen; whereas, in the case of the introduction of 30 per cent. of nitrogen, the inherent illuminating power was reduced by about 15 candles. Turning to the comparative effect of nitrogen and carbonic acid on lowering the illuminating power of gas, there again there were data in Dr. Frankland's paper which would assist them; and it would be recognized that the greater effect of carbonic acid lowering the illuminating power more than any other diluent was due to the specific heat of that gas, and consequently to the mere lowering of the temperature. The difference between the specific heats of carbonic acid and ntirogen was not very great. Taking nitrogen as 1, carbonic acid would be 1·4; and it seemed to him from these figures that it was an impossibility that the actual effect produced should be so very different as had been found in some experiments. It was most difficult to reconcile the different results obtained by different observers; but Mr. Hunt's suggestion that it was entirely due to the burners might go far to explain it. Even then, he must admit that it was exceedingly difficult to reconcile the various statements made. The effect of the different conditions of the burners would undoubtedly have a very considerable effect on the illuminating power; but he did not think even this would altogether account for the discrepancies found. At Ramsgate, and also at Shrewsbury, the effect on the gas seemed to be very much greater in the ordinary household burners than on the Referees' burner—the "London" Argand. It was exceedingly difficult to discuss a paper in which so many points were dealt with; and it was equally difficult to controvert carefully-made experiments, such as Mr. Hunt had brought forward. But he (Dr. Thorne) certainly thought that the result of a year's work at Shrewsbury and more than a year at Ramsgate—where the greatest care had been taken to get the figures absolutely correct—had shown that a small percentage of oxygen had a decided effect in increasing the illuminating power of the gas; and that the nitrogen, where air was employed, had the opposite effect. It was probably quite correct to say that the whole question lay in that of cost. Everyone would admit that, with costless oxygen, this method of purification would be most useful; and he himself felt confident that further experience would show that even the cost of the oxygen was more than compensated by the gain in the illuminating power of the gas, and the saving of space—a most important point. In spite of some diversity, the concensus of opinion seemed to be in favour of oxygen; and he believed that further experience would show that the results claimed for the oxygen process had not been excessive. Although they might not be able to explain exactly how the effects were produced, they were really obtained when working on a large scale.

Mr. C. C. Carpenter (Vauxhall) said, with reference more particularly to the two places to which Dr. Thorne had referred (where the oxygen process had been giving such excellent results), he would point out that at Ramsgate it was assumed that the large increase in illuminating power was obtained simply by the use of oxygen. It should, however, be borne in mind that in the previous year oxide of iron was used, and no lime; whilst last year oxide purification was substituted for lime, and the whole of the carbonic acid was removed. Then came the question of the sulphur difficulty. He understood that at Shrewsbury Mr. Belton introduced oxygen to avoid the nuisance of smell; and that he had no smell now from the lime purifiers. But if he drew in air, he would not have any smell from an oxide purifier; so that the comparison, was not between using air previously and oxygen now, but between purifying with oxygen and without air in the first place and with pure oxygen in the second. Their thanks were certainly due to Mr. Hunt for having put the matter so clearly before them with regard to the reduction of illuminating power by nitrogen. Apart from that, there could be no possible advantage in using oxygen. Coal contained 5 per cent. of sulphuretted hydrogen; and this sulphuretted hydrogen was the active chemical for producing the very compound in the lime boxes necessary for taking out the bisulphide of carbon. As the sulphuretted hydrogen was already diluted with 32 times its bulk of oxygen and marsh gas, how the addition of another 2 or 3 per cent. direct (in the form of nitrogen) could affect its action, he did not think any chemist could say.

Mr. Hunt (in reply) said, with regard to the question of back-pressure, he was somewhat nervous about trying the purifier with lime, having been accustomed to oxide first, and then lime for taking out the carbonic acid; and the lime purifiers in such cases invariably threw a very high pressure. But he was agreeably surprised to find, on turning the gas into the all-lime set of purifiers, that the pressure did not exceed that practically thrown by oxide of iron alone. This had continued ever since. Probably it was by accident that there had been a good and regular quality of the lime; for certainly the point Mr. Foulis had mentioned had not occurred to him, but it was a very probable explanation of the difficulty Mr. Colson had experienced. With regard to Dr. Thorne's question, two meters were used in each experiment; the second meter indicating the consumption of 5 feet by the burner. With regard to the height of the test flame, his experience was that the presence of carbonic acid in the gas elongated the flame, although it depreciated the illuminating power. There was invariably a much longer flame when a smaller quantity of carbonic acid was present in the gas. He regarded the "Methven screen" as the most invariable instrument for matters of this kind—it was so very far superior to candles, from which almost any result might be obtained, that he always used it. With regard to the height of the flame being influenced by the presence of carbonic acid gas, this fact had not been pointed out as referable to the Argand burner; or if it had been, it had quite escaped notice. It was always understood that the height varied with the Lowe jet; but in the case of the Argand also, not only was the height of the flame

influenced by carbonic acid, but also by the combustion of the gas. For the purpose of some experiments, they had distilled coal at a much lower temperature, and the gas so given off afforded a much higher flame, but with a reduction of illuminating power; so that the height of the flame in an Argand burner was not an invariable test. Dr. Thorne had quoted some figures from Dr. Frankland, giving the total increase and decrease in illuminating power produced by oxygen and nitrogen; and they appeared to correspond with the percentage he (Mr. Hunt) had given in the paper. He believed Dr. Thorne was associated with Dr. Frankland in some of his earlier experiments in this direction; and he (Mr. Hunt) should be glad if he would kindly explain how, in the face of these experiments, he could reconcile those small percentages of increase by Dr. Frankland's experiments and the very large increase now claimed from the use of oxygen in coal gas. He understood now that two candles increase was claimed for the use of oxygen.

Dr. Thorne said the experiments with which he was connected were not those referred to by Mr. Hunt, but some experiments with respect to the effect of benzene on the illuminating power of various gases. These were carried on by Dr. Edward Frankland—Dr. Percy Frankland's father. However, he accepted all the figures of Dr. Percy Frankland, who was a very careful investigator. He had quite felt (as he had said before) that there was a difficulty in reconciling the comparatively large effect produced in purification by oxygen with the effect obtained by him; but he would point out that the two candles increase claimed was not due to oxygen alone, but to the removal of the carbonic acid, and the disuse of the detrimental nitrogen. The claim put forward for the oxygen alone was substantiated by the results at Shrewsbury where lime was used before and no air, and where the only difference was the use of oxygen. He thought the effect of oxygen was greater than one could anticipate as due simply to the action of the oxygen in the gas-flame.

The President, in closing the discussion, said he should like to make a remark on a statement in the first passage of the paper, where Mr. Hunt stated that the London Gas Companies appeared to have entirely outgrown the aversion with which at one time they viewed the requirements of the Metropolitan Gas Referees, as to the reduction of the sulphur compounds. He did not think they had at all outgrown that aversion. The question of the removal of carbonic acid was an entirely different thing. They could remove carbonic acid without going to the trouble of removing the sulphur compounds; and they quite agreed with Mr. Hunt as to the improvement in the illuminating power to be attained by so doing. But the Companies were still of the same opinion as when they applied to Parliament with reference to the sulphur compounds—that it was doubtful whether "the game" was "worth the candle." It was becoming more and more troublesome to know how to get rid of the enormous quantity of spent lime produced. If it were simply a question of, carbonate of lime, there would be no difficulty in its removal, or re-burning it in some such arrangement as that shown by Mr. Stokes, or in one of Hislop's kilns.

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Mr. A. Colson (Leicester) read the last paper, which was illustrated by a large number of beautifully executed drawings, descriptive of

## THE LEICESTER GAS-WORKS EXTENSIONS.

The town of Leicester was, until the year 1879, supplied with gas from one works only—viz., the Belgrave Gate works. The productive capacity of these works—under 3,000,000 cubic feet per day, with a storeage of only 2,000,000 cubic feet—becoming insufficient for meeting the increasing consumption, the Leicester Gas Company, in 1875, purchased 32 acres of land near the village of Aylestone and adjoining the Leicester and Burton branch of the Midland Railway Company, upon which to erect new works. With the exception that it is much too near the residential part of the town, the site, from an engineering point of view, leaves little to be desired. On the east side it is bounded by the Aylestone Road, one of the principal highways to the town; on the west, by the River Soar and the Leicestershire and Northamptonshire Union Canal; on the north, by the railway already mentioned; while on the south till recently were open fields, now intersected by new roads. Lying some 7 feet below the level of the Aylestone Road, the land itself has provided a tip for all surplus excavation; while the railway, 17 feet above, affords excellent facilities for dealing economically with the transit of material both into and out of the works. In March, 1878, the foundation stone was laid for new works, from designs prepared by my predecessor, Mr. C. S. Robinson, together with his brother, the late Mr. G. A. Robinson, in conjunction with a local firm of architects, Messrs. Shenton and Baker. Shortly after this date, the gas undertaking was purchased by the Corporation. At the end of 1882, when the writer was appointed to succeed Mr. Robinson, works with an entrance from the Aylestone Road were completed, to produce 1,000,000 cubic feet per day, with 1,500,000 feet storeage. In addition, there had also been provided a second gasholder-tank, offices, a few workmen's dwellings, superintendent's house, and a clock tower. The retort-house, designed to make 2,000,000 cubic feet per day, was only half fitted with retorts. The yard level had been made to correspond with the level of the Aylestone Road, and the same level has been maintained throughout the works.

From this point the further extension of the works has devolved upon the writer; and these extensions it is his present intention to describe. A general plan of the proposed works had been prepared by the Engineers and Architects referred to for utilizing the whole of the land; but this plan has not been followed, with the exception that the avenue from the entrance has been continued through the works as originally intended. The buildings, too, though entirely different in character, correspond architecturally with those first erected.

For receiving and despatching material other than coal, which is taken direct into the coal-stores by high-level sidings, a hydraulic lift had been erected in one corner of the works, with 130 yards of siding running therefrom to the centre of the works. Materials of all kinds leaving the works were either carted, barrowed, or carried to some point along the line of siding, and loaded into railway trucks, which in turn were pushed to the hoist and raised to the high-level road. With the increasing quantity of material to be dealt with, consequent upon the increased make of gas, it was found that this method of transit was both slow and costly. It was therefore decided to construct sidings through the works, in direct communication with the railway above. In designing these, care and forethought had to be exercised—the difference of level being great, the distances to be travelled comparatively short, and the corners to be rounded, in some cases, right angles.

A siding leaves the high-level road at the back of No. 2 retort-house, descending to the yard below by an incline of 1 in 34. The incline merges into a curve of 180 feet radius, at the end of which a straight piece of road runs parallel to No. 1 retort-house till two curves, each of 80 feet radius, are reached—one turning to the right, and one to the left. Following the left-hand curve round the corner of the boiler-house, where it becomes part of a double line, the siding continues parallel to the end of No. 1 retort-house, a corner of which it again rounds in the form of a single line; and, with a curve of 70 feet radius, combined with an incline of 1 in 20, which carries this portion of the siding into a coke-loading dock running parallel to the side of the retort-house. The rail level in the dock is 5 feet below the yard level. Sidings have been carried to various parts of the works; but with curves less sharp and gradients somewhat easier than those described. In extending these sidings at various times, the object has been to lay them in such positions, and at such levels compared with the yard level, as to render them of the utmost utility, and to establish complete communication between the high-level railway, the Aylestone Road, and the river and canal. The outer rail of the sharper curves has a cant of 4 inches. Other coke-loading docks have been provided, with rail level 6 feet below the coping or yard level. At this depth the tops of the railway coke-waggons stand but 2 feet above the yard level. This is a great convenience in connection with coke loading, the cost of which since the sidings were made has been reduced considerably more than 1s. per ton; the total cost now not exceeding 4d. per ton. A corresponding saving has been effected in connection with the handling of all other material. Although care is required, no difficulty has been experienced in working these sidings with a locomotive having a 5 ft. 6 in. wheel base, 12-inch cylinders, 18-inch stroke, and weighing when loaded

18 tons. Five trucks containing 30 tons of coke are easily drawn from the deepest dock to the high-level road.

The foundations of the docks are formed of lime concrete, 18 inches thick and 5 feet wide, placed upon a 3-feet bed of hard clay, which occurs immediately under the original surface of the land. Upon the concrete are built the walls with four courses of footings forming the dock, standing 8 ft. 6 in. high with a batter of 3 inches. The dock at the top is 9 ft. 6 in. wide; and at the bottom, above the footings, 9 feet. The walls are three bricks in thickness, strengthened by piers four bricks thick, and 4½ bricks wide at 12-feet centres. They are built of common red bricks set in mortar and faced with blue brindled bricks, with joints raked out and pointed in cement. The walls are finished with a blue brick-on-edge coping, 18 inches wide, set in cement. The space between the walls is filled with ashes for a depth of 18 inches, upon which are placed the sleepers for carrying the rails. The space between the sleepers, after the road is laid, is also filled in with ashes.

In fitting the second half of No. 1 retort-house, it was decided to adopt the Klönne-Hunt system of regenerator furnace. The retort-house floor, being at the yard level, was lowered 5 ft. 3 in. Thirteen beds of eight retorts each, all of uniform size—viz., 22 in. by 16 in., ⌂ shape, and 29 ft. long—were constructed. The charging-floor was fixed at 3 ft. 3 in. above the old floor level. On the furnace side of the house, the charging-floor is formed of cast-iron plates laid upon rolled joists carried by cast-iron columns. On the opposite side of the house is a passage 6 feet wide, extending the whole length of the beds, to give access to the flues and dampers; the passage being covered with cast-iron plates laid upon light rolled joists. The remainder of the floor is formed by earth filling, paved with brick on edge. Two cross passages, 6 feet wide and 7 ft. 3 in. high, are provided, one at either end of the damper passage, for communication with the exterior of the retort-house. An incline and two flights of steps answer the same purpose on the furnace side of the house. The thirteen beds, comprising 218 mouthpieces, carbonize per day, at 16 cwt. per mouthpiece, 166 tons of coal, and produce, when in good condition, upwards of 1,600,000 cubic feet of gas. Ten of these beds are connected with the stack belonging to the first half of the house; for the remaining three beds a small stack is erected on the pier at the end of the bench. As the retort-fittings in connection with these beds are the same as have since been fixed in No. 2 retort-house, these will be described later on. The work when completed and put into operation, proved in every way most satisfactory. No little improvement is found in the condition of the coal delivered on the raised floor from the viaduct in the coal-store adjoining and 14 feet above, as compared with the coal delivered from the same viaduct upon the floor in the first half of the retort-house, 3 ft. 3 in. lower. Upon the lower floor, owing to the longer drop, the coal always contains at least three times as much small and dust as that delivered on the higher level. It is intended at some future time to refit the first half of the house to correspond with the second.

During the time that the carbonizing plant was being increased, additional apparatus was being erected in connection with every department of the works; in fact, their capacity throughout was increased to practically 3 million cubic feet per day. Previously the method of purification adopted had been the elimination of sulphuretted hydrogen by one set of four oxide boxes, 24 feet square and 6 feet deep, with a catch box of the same size. This set of purifiers was increased by an additional box of the same size; after which four were used with oxide of iron and two with lime for the extraction of carbonic acid. A duplicate set was erected and worked for a time in the same way; but latterly the first four boxes in each set have been worked with lime, and the last two with oxide. These additions, except the trussing of No. 2 gasholder, being similar to, though smaller than what was afterwards carried out in connection with No. 2 section, need not be described in detail.

In 1885-6, residual works were erected in the south-west corner of the land abutting on the river and canal. These works, divided from the gas-works by a watercourse, deal with the whole of the tar and ammoniacal liquor produced at the two gas-works. They cover about 3½ acres of land, and they will shortly be capable of manufacturing 100 tons of sulphate of ammonia, and of distilling upwards of 80,000 gallons of tar per week. The River Soar, at the lower end of the works, where it also forms a portion of the canal, has been doubled in width, and a good wharf made, off which a dozen boats can lie. To this wharf the siding from the gas-works has been brought, running on its way in the form of a double line along the whole length of the residual works, but 5 feet below the yard level. By this means materials and products of all kinds can be received or despatched at or from any point, by either rail or water, at a minimum of cost and inconvenience. As a separate paper would be needed to describe these works, no further reference will be made to them.

Four years ago, a further extension of the gas-works having become necessary, it was decided to erect a second section, equal throughout to about 4 million cubic feet per day. The retort-house, with coal-stores on either side, stands on the right-hand side of the avenue running through the works, with its front end lineable with No. 1 house. The house internally is 80 feet wide and 368 feet long; and the coal-stores are each 50 feet wide. A capital foundation was obtained for the building 8 feet below the surface—*i.e.*, 15 feet below the yard level. At this depth was reached the Keuper bed, consisting of a good hard red marl. Ground blue lias lime concrete, varying in width from 5 to nearly 15 feet, according to the width of the walls to be carried, was brought up throughout the building to the ground level. The end wall of the building, against which the high-level siding banks are formed, and which therefore had to be made sufficiently strong, measures 8 ft. 11½ in. thick at the yard level, and 6 ft. 7 in. at the sleeper level. The walls of this and of the other buildings are built of bricks of local make in old English bond, faced above plinth level with pressed red brick, obtained from the neighbourhood of Coalville. A small quantity of terra-cotta introduced into the front of this and some of the other buildings, as well as the radial arch bricks and moulded string courses and tiles, were obtained from the same locality. The angles in the several openings and the first outside ring in the arches in the division walls between the retort-house and the coal-stores are built in blue bull-nose bricks. Inverted arches the whole thickness of the walls, and four rings deep, are turned under all openings in the walls of the retort-house and coal-stores. The stone used for pads, corbels, caps, sills, copings, and strings is all best hard Derbyshire. A plinth 3 ft. 6 in. high, of blue brick, is carried round the building; and the pilasters are all finished with blue slope bricks. The retort-house is intended to hold 30 beds of eight retorts each; but at present it is only fitted with 16 beds, capable of producing a little over 2 million cubic feet of gas per day. The floors are arranged as in the second half of No. 1 house—that is to say, the charging-floor is 3 ft. 3 in. above the yard level, and the basement or clinkering floor 5 ft. 3 in. below. The charging-floor is formed of cast-iron plates, &c., as described later on. For a width of 15 feet from the face of the beds, the plates are chequered; the remaining plates, from which the coal is shovelled, being plain. The clinkering-floor is paved with brick on edge. The distance from the charging-floor to the wall-plate level measures 31 ft. 6 in. Special care has been taken to secure efficient ventilation by suitable openings in the end and side walls of the house, as well as by an open louvre made of cast iron, 3 ft. wide, along the ridge of the roof, running almost the entire length of the building. The roof of the retort-house is one span, and, while of a substantial character, is of the greatest simplicity. The whole of the rafters and struts are formed of T-iron; but the other members consist of flat bar iron, with the exception of the wind-ties, which are of round iron. With a view of reducing skilled labour to a minimum, all jaws, eyes, screw ends, welds, &c., have been dispensed with, and the junctions secured by rivets. This applies also to the coal-stores and other roofs in connection with No. 2 section. The roofs throughout the works are covered with the best selected Penrhyn slates, fastened by lead nails.

The retort-beds are similar to those mentioned in connection with No. 1 house, and consist of 8 retorts each, ⌂ shape, 22 in. by 16 in., and 22 feet long, but are heated by a simply-arranged regenerator furnace. They are set in arches 9 feet in the clear, with the usual arrangement of up and down flues, and are fitted with self-sealing mouthpieces and lids. The ascension-pipes are 8 inches reducing to 7 inches in diameter; the bridge-pipes, 8 in.

by 7 in. in front and 12 in. by 7 in. at the back; and the dip-pipes, 7 inches—all external dimensions. The hydraulic mains, made of wrought iron, are nearly rectangular in section, 36 inches across and 26 inches deep; the bottom formed with a slope from front to back. To ensure the removal of the tar from the bottom of the main, a hood, made of sheet iron, is fixed in front of the gas outlet reaching 6 inches above the level of the outlet, and to within 4 inches of the bottom of the deeper side of the main. There is a separate main for each bed of retorts, at either end, provided with means for running off thick tar, and also with a steam supply in case of the formation of pitch. The hydraulic and gas mains are kept free from the brickwork; being carried by rolled joists attached to the buckstaves, which are made of bulb iron. The gas, tar, and liquor are taken off, and carried together by a 24-inch main, to the end of the retort-house, from which point the tar and liquor travel by gravitation to the store-tanks. It is intended to divide the retort-house, when completed, into two sections of 2 million cubic feet each. This division will continue through the works to the outlet of the station meters, where the gas from the two subsections will unite, and be conveyed to the gasholders by a 36-inch main. Up to the inlets of the meters the mains are 24-inch. The retorts are arranged vertically—three on either side, and two in the centre—over the furnace; a good space being left between the lower retort and the furnace arch. The generator is 1 ft. 8 in. wide at the bottom fire-bar level, 2 ft. 8 in. at the springing of the furnace arch, and 5 ft. deep and 5 ft. 6 in. long to the flare bed. For convenience of firing, the furnace projects 4 feet beyond the face of the retort-bed. The arch of the furnace is entirely composed of Ewell bricks. The regenerator is a simple arrangement of four tiers of three flues each, placed side by side, and formed of ordinary tiles. The secondary air supply is conveyed through the middle passage; and the exit gases go through the two outside passages. The draught is supplied by a stack 4 ft. 6 in. square inside, and projecting 65 feet above the ridge of the retort-house roof. A similar stack is intended for the second half of the house.

The charging-floor of the house consists of cast-iron plates, $\frac{7}{8}$ inch thick, carried upon 16 in. by 6 in. by 6 in. rolled joists, supported by cast-iron columns, 10 ft. 6 in. centres. The coal-stores on either side of the retort-house, and of the same length, are capable of holding, together with what can be placed upon the charging-floor of the retort-house, 14,000 tons of coal; being equal to five weeks' supply with the house working at its maximum. With the exception of about 50 feet at either end, the floor of the stores is on a level with the charging-floor of the retort-house. At the ends referred to, the floor is raised 9 feet, and formed of cast-iron plates carried on rolled joists. This has been done owing to the close proximity at these points of the passages affording communication between the charging and clinkering floors of the retort-house and the coke-yard. The coal is delivered into the stores by viaducts, the rail level of which is level with the Burton line, but 14 feet above the level of the stores and the charging-floor. The viaducts are supported by the division walls of the retort-house and coal-stores and by cast-iron columns placed at distances varying from 22 ft. 6 in. to 25 feet. The superstructure of the viaduct consists of a compound girder built of rolled joists with top and bottom flange plate. Upon the girder carried by the cast-iron columns are placed cross joists, with one end of each resting on the division wall already referred to. Upon these rest two longitudinal joists, to which are secured the rails. A planked and chained platform is formed on either side, for the safety of the workmen. For the passage of coal from the stores to the retort-house, there are fourteen 12-feet arched openings in the division walls; and for communication between the yard and the charging and clinkering floors of the house, are inclined passages 9 feet wide, passing through the coal-stores. Although the retort-house is practically a stage house (the basement floor being upwards of 5 feet below the ground level), the coke is drawn into barrows on the charging-floor, and from thence wheeled to the yard. The whole of the rolled joists used in connection with the retort-house are made of steel, of English manufacture. In the yard on either side of the house, at a distance of 70 feet, and running parallel to it, is a coke-loading dock, about 300 feet long, and capable of holding a good train of railway waggons. These docks are used not only for loading coke, but also for loading and unloading every description of material coming into or leaving the works.

The condensers used in connection with this section as well as in No. 1 section are of the battery type. When the section is complete, two of these are to be placed on either side of the retort-house, lineable with its end; each capable of dealing with a million cubic feet of gas per day. At present two only are fixed, equal to the present producing power of the retort-house; but the foundations are already in for two more. Each condenser is 40 feet long, 18 feet high, and 2 ft. 3 in. wide, and is perforated with 4-inch tubes, and divided into bays by cast-iron division-plates, with openings top and bottom alternately. The flanges are faced, and the joints throughout made with Vulcan cement. The foundations for the condensers are in some places as much as 12 feet below the yard level. Upon completion, the condensers were tested with air at a pressure equal to 18 inches head of water. For the purpose of regulating the temperature of the gas, curtains made of tarpaulin material are worked upon runners fixed at the top and on either side of the condenser. By this means the temperature at the outlet is under easy control.

Immediately at the back of the condensers are placed, in pairs, the tar and liquor store-tanks. The whole of the storeage intended for this section is already completed. It consists of four cast-iron tanks 50 feet in diameter and 11 feet deep, giving 500,000 gallons total storeage capacity, equal to four weeks' make of tar and liquor. The depth of these tanks had to be regulated by the level of the water in the ground, which, unfortunately, is only too near the surface. Between each pair of tanks on the farther side from the condensers is placed a pump-room, with a cast-iron measuring-tank overhead. In these are fixed 6-inch vertical tar and liquor pumps.

Facing the end of the retort-house, on the opposite side of the avenue, stands a block of buildings 240 feet long and 36 feet wide. The centre of the block consists of one storey only; but about 70 feet of each end is carried up a second storey. On the ground floor are arranged the carpenters', fitters', painters', and smiths' shops, boiler and exhauster rooms, and foreman's office. In the storey over the carpenters' and fitters' shops are provided a workmen's mess-room, 72 feet long and 23 feet wide; also a wash-house and bath-room. At the opposite end of the block, and over the exhauster-room, is placed a reading and recreation room—a well-appointed apartment measuring 56 feet long and 34 feet wide. Adjoining this is a small committee-room, for the use of the reading-room members. In the boiler-house are fixed three of Babcock, Wilcox, and Co.'s patent boilers of 90-horse power each; and in the exhauster-room, two of Donkin's improved exhausters and engines, equal to 100,000 cubic feet per hour each. Space is left in both engine-room and boiler-house for further apparatus. Wrought-iron casements are used in this building, which is well lighted and ventilated throughout. A stack, 90 feet high, is erected in the centre for the boilers, but placed at the back of the building.

At a few yards distance from the block just described is placed at one end the meter-house, and at the other a locomotive-shed. In the meter-house there is room for two 80,000 cubic feet per hour meters; but at present only one has been erected, though the foundations for a second have been built. In the locomotive-shed, space has been allowed for standing two engines, and for doing general fitting repairs.

At the back of the exhauster-house is fitted one of Kirkham, Hulett, and Chandler's "Standard" washer-scrubbers, having a capacity of 2 million cubic feet per diem. Before next winter a Livesey washer will be placed between the machine and the exhausters. The ground between the back of the shops and the boundary on the south side is occupied by the gasholder-tanks and holders, purifiers, and revivifying-shed. The system of purification adopted is the sulphide of calcium process for the elimination of the sulphur compounds. The purifiers are each 32 feet square and 6 feet deep. The lime boxes are fitted with four trays for carrying the material, and the oxide boxes with three. The set, intended for 2 million cubic feet per diem, consists of eight boxes—the first two for lime followed by three for oxide, two for sulphide of calcium, and lastly a catch box. The purifiers, which are placed in the open without any covering, stand upon brickwork

and concrete foundations, with the bottom of the lute at the ground level. Wood disc-valves are used in connection with all the boxes, with the exception of the bye-passes, where side-valves are employed.

The revivifying-shed stands on one side of the purifiers. It is 307 feet long and 60 feet wide, and consists of a roof of two spans, each 30 feet, supported upon cast-iron columns. For ventilating the roofs, a cast-iron louvre runs from end to end of each. A siding passes within a short distance of either end of this shed. At the meter-house end the rail is level with the revivifying-floor; but at the opposite end, where the siding descends on its way to the chemical works, the rail level declines from 1 ft. to 3 ft. 6 in. below the coping or floor level. Arranged thus, it is exceedingly convenient for the removal of material to or from the shed and purifiers. Storeage for spent lime, &c., is allotted between the two couples of gasholders. Into this area are carried two short sidings, each sunk 3 feet below the ground level.

To economize space, it was decided that the gasholder tanks should be of the twin description; and in order to minimize the amount of excavation and the risk of tapping the existing and adjoining tanks (one of which was already leaking), coping level was fixed at 3 ft. 6 in. above the yard level. The tanks are 200 feet in diameter and 38 feet deep to the rest-stones. They are constructed of brick-work and puddle; the walls being faced with hard brindled bricks. They are built without wells; the inlet and outlet pipes, 36 inches in diameter, being encased in 2 ft. 6 in. of puddle. The division wall is 5 ft. 6 in. in thickness. The bank encircling the tanks—10 feet wide at the top and 20 feet at the bottom, with the slope from the top to the lower or yard level covered with turf—makes a neat and clean finish to the work; and its green and fresh appearance is often the subject of remark by strangers visiting the works. In making the tanks, although running sand and silt were largely met with, a good foundation was found in the Keuper bed already referred to. Being so near the river, a great quantity of water had to be dealt with; but the work was carried out without any great difficulty.

The description of gasholders to be adopted, whether of two or three lifts, was the subject of no little consideration. As the position they would occupy is a very exposed one (standing at the mouth of an extended valley, and subject to heavy gusts of wind), and as one holder only was at first to be erected, which would necessitate the second being constructed with the water in the tank, telescopic two-lift untrussed holders were decided upon, having a capacity of 2¼ million cubic feet each. The guide-framing consists of 22 cast-iron columns of seven lengths each, provided with turned and faced external flanges standing upon circular bases. The columns are of the same form throughout, but slightly tapering, and without entablature or any other source of weakness. They are connected by wrought-iron lattice girders; the lower tier being made continuous by angle-iron straps carried round the columns, and secured to the top and bottom angle-irons of each girder. The base of each column is made unusually strong by 12 internal cast-iron webs running from top to bottom. The framing is braced by tie-rods. The trussing for the support of the crown of the holder is made entirely of iron. It consists of a skeleton frame formed of 36 rolled joists, 6 in. by 3 in. by 3 in., radiating at equal distances from the centre, and bent to the correct curve of the crown of the holder. The joists are stiffened at frequent intervals by angle and flat bar purlins, with an outer purlin formed by 6 in. by 3 in. by 3 in. rolled joists. The framing is carried by 99 cast-iron columns of various heights, braced both radially and circularly by tie-rods, and secured to brick piers built within the tank.

In carrying out the work, both materials and workmanship were subject to constant and thorough supervision. The wrought iron used in the more important parts of the work was specified to bear a tensile strain of 22 tons to the square inch. Mr. D. Kirkaldy's tests show that this strain was generally exceeded before fracture took place, and that the reduced area after fracture varied from 11·4 to 38·77 per cent. according to section. In two instances the reduced area amounted to as much as 48·7 and 43·4 per cent. respectively; but these results were obtained from a special quality of round bars. As regards the cast iron, bars 2 in. by 1 in. and 40 in. long, placed upon bearings 36 inches apart, were specified to sustain 28 cwt. As an additional precaution, however, against inferior iron being used, a certain number of the retort-house floor-plates—10 ft. 6 in. long, 2 ft. 6 in. wide, cast ⅞ inch thick, and with four ribs 7 inches deep at centre—were specified to be tested by a distributed load of 34 tons. After some little experience on the part of the contractor, who considered such a test crucial, not only did the plates carry the load required, but as much as 50 tons was carried before fracture took place. As evidence of the care with which the columns of the gasholder framing were cast, it may be mentioned that the greatest variation in thickness of the metal, ascertained by drilling, did not exceed an eighth of an inch.

The total cost of carrying out the works referred to in this paper has amounted to about £165,000—viz., £20,000 on the residual works, £35,000 on the extension of No. 1 section of the gas-works, and £110,000 on the erection of No. 2 section. A further outlay of about £40,000 will be required to make the manufacturing portion of No. 2 section equal to 4 million cubic feet per diem, and the storeage to 4½ million cubic feet. The total cost of this section, when completed, will not exceed £150,000, or £37,500 per million cubic feet.

The area of the ground occupied by the two sections, which, when completed, will be equal to a productive capacity of a little more than 7 million cubic feet, and a storeage of 7½ million cubic feet of gas per day, will be about 17 acres. This includes the ground occupied by the superintendent's house and the workmen's cottages, gardens, &c.

In concluding this paper, the writer has pleasure in referring to the assistance rendered him in carrying out these works by two members of his staff—Mr. H. E. Clayton and Mr. W. G. Clements—who have acted as draughtsmen and clerks of the works.

*Discussion.*

The PRESIDENT was sure the meeting was very much indebted to Mr. Colson for this paper. It was one of the most elaborate accounts of a gas-works installation which had come under his notice. It reflected the utmost credit on Mr. Colson and those associated with him.

Mr. W. KING (Liverpool) said no doubt many gentlemen present had had the opportunity of seeing the works Mr. Colson had described. There were, however, many who had not; and as some time ago he was conducted over the whole works, he should like to express, on his own part, his great admiration of what he had seen. There were no works in the kingdom which surpassed the Leicester works in beauty of arrangement, and the facility they afforded for carrying out all the operations of a gas-works in the most economical manner. There were, of course, in London and elsewhere works which exceeded them in size; but of all the works he had seen in the kingdom, there were none to surpass those at Leicester. The whole of the details had been admirably thought out; special attention being paid to the comfort of the workmen. The arrangements were such that he thought, in some of the London clubs, gentlemen would be glad enough to find the accommodation provided in what was modestly spoken of as the "reading and recreation rooms." He hoped the Institution might some day have the pleasure of inspecting the works, when he was sure the members would corroborate what he said about them.

Mr. G. E. STEVENSON (London) heartily endorsed what Mr. King had said with regard to the admirable arrangement and plan of the works which Mr. Colson's designs showed. It was impossible to criticize such a paper in detail; but there were one or two points on which he should like to ask a question. Mr. Colson said the coke was not brought down to the floor of the retort-house, but was wheeled away by the yard level; yet he understood the charging-floor was some 3 feet above. How did he arrange for delivering the coke into the yard? Was it by an inclined plane? In a retort-house he had constructed in South America with a regenerator furnace, of course he had a basement; but he did not extend the walls of the basement the full width, which was not necessary as the vaults were not to be used for coke. The basement was, therefore, built a narrower width than the house, which made a considerable saving in the walls and foundations. A separate main for each bed was referred to; and he presumed that this meant that each bed of retorts had a separate hydraulic main. His own plan was to put a separate hydraulic main on to each setting,

and connect each of these by a foul-main running at the back of them. This arrangement might be divided into as many sections as he thought necessary. It was specially desirable to separate every retort-setting from its neighbour; so that it might be entirely shut off if necessary, so as to avoid the possibility of drawing air with the exhauster through the beds not in use. He should be glad to know if Mr. Colson found the Babcock boilers were advantageous. He had seen them at work at pumping-stations, and his impression was that they were almost too complicated for gas-works. He knew they were especially designed for economy of fuel; but that was hardly a matter of first importance in their case. Then, again, he might point out that 90 feet seemed rather an excessive height for a chimney shaft; and the retort chimneys also struck him as very high for settings on the regenerative plan, where a strong draught was by no means desirable. With regard to purification, he noticed on the previous day at the Kensal Green works that the system followed was very simple; the lime purifiers being worked in rotation three at a time, and the gas afterwards passed through oxide. The original system of purifying from sulphur compounds appeared to him to have been abandoned. In the time of Mr. R. H. Patterson, when the first difficulty arose as to sulphur purification, the most elaborate arrangements were made to take out, first the carbonic acid, then the greater portion of the sulphuretted hydrogen, and then to pass the gas through a separate purifier, which had been previously sulphided by gas containing sulphuretted hydrogen, after which it went through catch purifiers. Mr. Colson certainly had more purifiers than appeared to be used in the present London arrangement; and it struck him (Mr. Stevenson) that it was not so perfect a method as first devised, but seemed to be a compromise between what was absolutely necessary and the old process. He might mention that his own method in constructing gas-holders was to have the flanges of the columns inside; and he thought the top portion would have been lighter with iron uprights and wooden rafters. The only point which could be called a criticism of the paper was as to the somewhat excessive storeage capacity beyond the manufacture. He did not know whether this was found necessary. But in former times it was considered that 80 per cent. for storeage was a workable quantity; and he did not know that it had ever been proposed to have the storeage in excess of the make.

Mr. HUNT said, although he had not had the pleasure of seeing the latest development of the Leicester works, he could bear testimony to the thoroughly practical manner in which they had been conceived and carried out. This practical spirit had been well illustrated in one particular—namely, the abandonment of waggon-hoists for lifting the material from the low level to the high, and the adoption of a simple line running throughout the whole works and commanding practically every portion of it. The details were shown in such admirable profusion on the plans exhibited, that it would be a wonder if there were not room for some difference of opinion with regard to them; but he did not know what end would be attained by dwelling on these points. It was the general plan of the works they were most interested in; and that was beyond criticism. He might be allowed, perhaps, to answer the question put with regard to the Babcock boiler. He first saw this boiler in use at Mr. Linton's works at Leith; and the report he gave of it was so satisfactory that, when requiring a new boiler for Birmingham, he introduced one. It had been in use for two years; and in his experience it was very suitable for gas-works purposes. It was not an economical boiler, and did not compare favourably with the Lancashire type for economy of fuel; but that was not the first consideration in a gas-works. It was admirably adapted for burning very small fuel or dust; and with a simple arrangement of a perforated grate, they found they could maintain steam with the siftings from the breeze screened through a ½-inch mesh. They intended to extend its use in future. With regard to the matter of storeage, he thought they had years ago outgrown the idea of 80 per cent. being sufficient. The more storeage one could have in a manufacturing town, the better; it was a safeguard against sudden emergencies. It was necessary now-a-days to provide a much larger margin than in times past; and having been used for some time to a very large surplus of storeage, he should be very sorry indeed if it became diminished.

Mr. COLSON, in reply, said the coke from the retort-house at Leicester was received on the charging-floor 3 feet above the yard level; and an incline led from that to the yard outside. The hydraulic mains were two to each bed of retorts; each bed being distinct. The question as to the Babcock boiler had been answered by Mr. Hunt, and also as to the storeage. The chimney he had arranged for was perhaps a little high; but he always thought it better to have rather too much power than too little. With regard to the purification, he had not the slightest idea what system was in use at Kensal Green; for his whole time the previous day was devoted to the inclined retorts. He had eight purifiers; but they were never all at work at the same time. Rarely more than two oxide boxes were used together; and never more than one sulphide of calcium box. Of course, every engineer had his own idea with regard to details; but he certainly preferred outside flanges to gasholder columns, as being more mechanical, and he should never think of putting them inside.

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**Mr. J. W. Schofield** has been appointed Manager of the Huddersfield Corporation Water-Works, in place of the late Mr. J. Stanway.

**Mr. W. B. Mimmack** has been appointed Secretary to the Crays Gas Company, in succession to Mr. F. M. Edwards, whose death we recently recorded in our columns.

**The Pintsch System of Lighting Railway Cars.**—Postal cars are now being run by the Richmond and Danville Railway Company of America, between Atlanta and Washington, lighted with the Pintsch gas. The Baltimore and Ohio Railway are also arranging to equip their postal cars with the light. "This," says the *Railroad Gazette*, "is certainly a decided step ahead, when we consider the large amount of mail which has been destroyed by fire, and the further fact that postal clerks have been required to work by dim lanterns, entirely inadequate to the difficult service they have to render."

**Utilizing the Waste Gas from Coke.**—M. Guyon, of Paris, has devised a plan for utilizing the waste heat of coke. A ton of coal will yield on distillation nearly 15 cwt. of coke. When this is drawn from the retorts and quenched, the gas generated passes off into the atmosphere, and goes to absolute waste. This gas is non-illuminant, it is true; but its calorific, and therefore dynamic, capacity is equal to that possessed by the gas produced by the distillation of coal. M. Guyon claims to obtain, by quenching the coke in a closed chamber instead of in the open air, 5700 cubic feet of heating gas per ton of coal, in addition to 10,600 cubic feet of lighting gas yielded by distillation, and this at a sacrifice of only 83 lbs. of coke. The theory of the process is that, on water coming into contact with the incandescent coke, its steam becomes decomposed into hydrogen and carbonic acid, while the latter is transformed into carbonic oxide. The generation of this latter gas is continued until the temperature of the coke falls from 1200° or 1300° to 600° C., between which and 400° C. hydrogen and carbonic acid are evolved; but the latter is no longer transformed into carbonic oxide. Below 400° C. steam is still generated, and may be utilized in the manner described above with the next charge of coke drawn from a retort. The inventor claims to be able to produce this heating gas at an expense of only 0·75 c. per cubic metre; and he thinks it is capable of being utilized in a gas-engine.

**An Ancient Reservoir.**—Considerable interest, from an historical point of view, is attached to some work carried out within the past 18 months by the Gas and Water Company of Tunis, and referred to, at the time, in *Le Génie Civil*. It involves the restoration of the old covered reservoirs of Carthage, which are said to date back fully 2000 years. It appears that these reservoirs form a block measuring 420 feet long by 89 ft. 6 in. broad. The interior of the block is divided into eighteen compartments, all of which are in communication with each other and with the incoming and outgoing conduits. During their long existence, these cisterns have passed through four periods, alternately of repairs and neglect, evidences of which are furnished not only by the different varieties of masonry occurring where repairs have been effected, but also by the character of the various layers of deposits on the walls of the tanks. The first layer of this deposit probably dates back to the time of Hannibal, when the cisterns were in full working order. It is very uniform, and apparently corresponds to a considerable lapse of time. That portion which was first deposited is yellowish, becoming whiter as time went on, and more care was taken with regard to the quality of water impounded. After the Roman conquest, the tanks fell into disuse, and the water in them rapidly became foul; an irregular dark-coloured layer being deposited on the sides. The Emperor Adrian repaired the tanks and impounded certain waters; and during this period a third layer, pure and white as the first, was deposited. But this state of affairs was put an end to by the irruption of the Arabs in 697; and since that time the cisterns have been entirely neglected. During this period the fourth layer was deposited, which is similar, in all respects, to the second.

# ESSAYS, COMMENTARIES, AND REVIEWS.

## GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1032.)

AFTER the depressing close of the Stock Markets preparatory to the vacation, it was not to be expected that the reopening on Tuesday would be a bright one; and, to add to the gloom, the wet weather ruined the Whitsuntide traffic, and made railways flat. At times during the course of the week, there was some faint show of a tendency to improve; but transactions were, on the whole, so limited, that there was not enough influence in any quarter to make itself felt. The most cheerful feature in the week was the improved position of the Money Market, thanks to the 5 per cent. rate. The Foreign Market is still in a very dismal plight, notwithstanding some small apparent rallies from time to time. The Gas department has been fairly active, and home undertakings are steady, and for the most part unchanged. The chief feature in the department is the large number of transactions effected in the debenture, preference, and limited issues of Gaslight. The "A" has been only moderately dealt in at prices ranging from 240½ to 243½; but the rest of the alphabet have been very prominent, and have commanded good prices. The only one, however, to move was the "B," which is quoted 1 higher. Of South Metropolitans, the "B" alone has attracted any business. It realized high figures, good enough to warrant a rise in the quotation; but the nominal price was left unchanged. A single transaction that occurred in the old stock was all the business marked in Commercials. Among the Suburban and Provincial undertakings, nothing was touched except British, which was in good demand; and the selling price was put up 1 higher. Foreign Companies furnish the only instances of a relapse in quotations. Foremost among them is Imperial Continental, which was done as low as 225½; but, rallying slightly afterwards, it closed at 227½. The quotation shows a fall of 3½. The other Continental Companies are quiet and firm. Malta and Mediterranean has recovered ¼. There was not much done in any of the rest; and the only other change is a reduction of ½ in Buenos Ayres. In the Water Companies, moderate business was effected; but prices all round were decidedly poor, and showed a tendency to general weakness. In the result, Lambeth 10 per cents. fell 1½; but the 7½ per cents. limited rose 2.

The daily operations were: At the reopening on Tuesday, Gas stocks were for the most part very firm, especially Gaslight "A," South Metropolitan "B," and British. Imperial Continental, however, fell back 1½, without business done. A little was done in Water, at only middling prices. Gas was much quieter on Wednesday; but the tendency was favourable. British rose ½; and Malta and Mediterranean, ¼. A few Water stocks changed hands; prices showing no disposition to amend. Thursday's Gas business was mostly in Gaslight secured issues, all of which were firm. Imperial Continental receded 2 more. Water was without any feature. Gaslight secured issues were again to the front on Friday; "B" rising 1. Nothing else was touched. In Water, the changes in Lambeth already noted occurred. Saturday was one of the busiest days of the week; Gaslights of all sorts and Imperial Continental being brisk, but unchanged. Buenos Ayres fell ½. Nothing at all was done in Water.

## ELECTRIC LIGHTING MEMORANDA.

**Railway Train Lighting—M. de Meritens' New Battery Investigated—Electric Lighting a Bye-product of Steam-Heating Plant.**

A PAPER on "Railway-Train Lighting" was recently read before the Institution of Civil Engineers by Mr. W. Langdon, who laid stress upon the advances which, as he contended, the system of incandescent electric lighting has made for this purpose as compared with oil and gas. After describing the principal methods in use, the author remarked, in conclusion, that the main points to be determined are whether or not electricity, as applied to train lighting, is safe, reliable, and less costly than other illuminants. He replied to himself that the fact that electrically-lighted trains have now been running for a considerable period without accident, is conclusive evidence of its safety; and he remarked that experience has shown that there is no reason to doubt its reliability where efficient provision has been made. Mr. Langdon went on to assert that when the cost of applying any of the illuminants—whether oil, gas, or electricity—to a complete railway system, is taken into account, the latter will be found the most economical. He reckoned the cost of burning an ordinary railway carriage oil-lamp at between ½d. and 1d. per hour. Compressed gas, according to statistics cited, costs from 0·045d. to 0·250d. per lamp per hour. The partial electric lighting of Midland trains was stated "not to greatly exceed ½d. per lamp per hour." Of course, the paper regarded electricity as the illuminant which will at no distant date be universally employed for train lighting. Another draft upon the Bank of the Future! When will electricians understand that these "promissory notes" are at a worse than Argentine discount? Meanwhile, it is very comical to see the *Electrical Review* offering by way of endorsement to Mr. Langdon's prophecy, the comment that "it seems probable that the introduction of electric incandescent lamps has stopped, temporarily at least, the progress of gas." The erection by the Great Northern Railway Company, at Holloway, of the largest Pintsch gas-works in the country, and the arrangements in progress for supplementing this station by another at Doncaster, are the best reply that can be adduced to these vapourings.

As we supposed at the time, there is something very "fishy" about the wonderful new primary battery of M. de Meritens, mentioned in this column a fortnight ago. After much reflection the inventor submitted his battery to be tested at the Central Electrical Laboratory, where, although the officials seem to have been extremely complaisant, it turned out to be neither novel nor particularly good. M. Hospitalier had previously said some very depreciatory things of this great invention, to which M. de Meritens objected; and the official test was supposed to be made in order to ascertain the truth of the matter. This is now settled in practical agreement with the results announced by M. Hospitalier; and so it must be concluded that the powerful industrial primary battery, which is to develop electro-motive force from zinc at a cost comparing favourably with energy obtained from the combustion of coal, is still to seek. What a pity it is that so many inventors deceive themselves and attempt to delude the public by cackling before they have laid their egg! Some innate longing of the human mind must dispose men to this foolishness, in utter defiance of the certainty of speedy discovery and denunciation.

We somehow received the impression that in settling the terms of their electric lighting concessions, the Paris Municipality made a great point of the preference to be given to French plant and apparatus. There must be some mistake about this, however, for we notice that at the recently opened electric lighting station of the Place Clichy, which was inaugurated with great ceremony by M. Alphand, Director of Public Works for the City of Paris, there are reported to be three Arlington and Sims steam-engines, each working two Siemens dynamos; besides some Corliss engines, also working dynamos of this type. We likewise read of a regulator of electrical pressure upon Elihu Thomson's principle. True, the contract for the construction of the station was taken by an Alsatian Company; so there may be some consolation to Chauvinistic feeling in this fact. But what has become of French electrical and mechanical art and industry, when the Parisians have to make use of electric light generated by American motors out of German machinery? We seem by this indication to have travelled far from the days when M. Jablochkoff was hailed as the enlightener of the universe.

A curious discussion upon the economical utilization of the exhaust steam of electric lighting engines for warming buildings in connection with such installations, was held at the last meeting of the National Electric Light Association of America. It seems that on the other side of the Atlantic, as here, the short time that electric lighting plant is profitably employed during every 24 hours, even in the depth of winter, seriously troubles the minds of the managers of electric light companies, who are at their wits' end to devise some means of profitably employing the steam plant while the dynamos are not in use. It has accordingly been discovered that the exhaust steam from the engines will serve to warm offices, corridors, &c., and even that it will pay in some localities to send out live steam for this purpose during the day, when there is no exhaust steam available. The existence of steam-heating companies in some cities of the United States has doubtless suggested this branch of business to the managers of electric lighting stations. Unfortunately, it must fail them throughout the summer months, or just when the lighting work is most unprofitable. Perhaps the electricians will rise to the emergency, and carry their search after a supplementary occupation for their steam-engines to the extent of utilizing them to drive ice-making machines during the hot season. If the testimony of Dr. R. S. Bishop is to be relied upon, the development of the steam-heating business by electric light companies is capable of being pushed so far as to change places with the lighting work, and, becoming the main source of profit, put the electric lamps into the second rank. It is a strange revelation of the very partial success, in the commercial sense, of electric lighting, even in the United States, when one of its best-instructed partisans can already bring himself to speak of it as playing the second part to steam-heating in the service of a community. The fact shows at least that the limitations of the electric lighting business are already pretty well ascertained in Mr. Edison's own country.

**Mr. Percy G. Winstanley** (son of Mr. W. Winstanley, of Newcastle-under-Lyme), who is at present Manager and Secretary of the Halesowen Gas Company, has been appointed Engineer and Manager of the Nuneaton Gas-Works. There were about 40 applications for the post, in response to the advertisement which appeared in the JOURNAL a few weeks ago.

**A Generous Gift from a Gas Manager.**—Mr. Peter Simpson, Engineer and Manager of the Rugby Gas Company, has lately handed over to three Trustees 30 original fully-paid shares in the Company. Part of the dividend is to be used to pay for an annual free bed in the Rugby Hospital; and the remainder is to be added to the capital until the whole is of the value of £1000—the amount required for a free bed in perpetuity. The gift is in connection with the Congregational Church, Rugby, and is primarily, but not exclusively, for the use of the members or their friends. It is in memory of Mrs. Simpson, who met with her death in a lamentable accident nine years ago.

## INCLINED AND HORIZONTAL RETORT WORKING.

The discussion on Mr. M'Minn's paper at the recent meeting of the Institution of Gas Engineers must be esteemed as by far the most important exposition of facts and opinions respecting carbonizing and coal-handling machinery for gas-works that has been offered to the gas engineering world for many years. It sums up, in a sense that must be taken as in no small degree authoritative, current intention and practice in connection with the heaviest division of the work of gas manufacture. There is nothing that just now occupies the solicitude of gas engineers and managers more than carbonizing methods. In effect, the contemporary problem of carbonization is susceptible of division into two separate yet allied problems—the first being what sort of gas to make; the second, how to make it. It is a point upon which the Institution may be congratulated, that the programme of the first meeting contained such worthy presentments of both of these problems of carbonization as those offered by Messrs. Foulis, Goulden, and Glasgow in the one kind, and Mr. M'Minn in the other. Good as the papers were, however, they were even more valuable to gas engineers generally as means of eliciting discussion. With regard to Mr. M'Minn's subject, for example, there is not much to be said on the question of labour-saving stoking after the modern fashion, that was not at least hinted at in the ample debate on the paper and the Kensal Green object-lesson. We desire to draw particular attention to this circumstance, and to assure students of modern carbonizing practice that the last number of the Journal contained the best information that can be found at present concerning retort working and coal handling.

Yet it may not be superfluous for us to draw from these statements of fact and judgment one or two additional deductions, which further examination of the reported discussion supplies. The idea of setting retorts at an angle, with a view to taking advantage of gravitation for facilitating the task of charging and drawing, has evidently gained possession of the gas engineering mind with a strength of grip that is simply astounding, having regard to the circumstances. That an old "dodge" such as this should have been revived and endowed with so much attractiveness in the eyes of men to whom the mechanical history of their industry must presumably be as familiar as the multiplication table, is a very high testimony to the genius of the individual who has officiated as the revivalist in this connection. M. Coze deserves all the credit that can be fairly assigned to the man, who, rummaging among the dust-heap of old technical devices, discovers something that can be restored to usefulness by being newly fitted with better appurtenances, and by having its bad elements cut away. Everybody knew that inclined retorts had been tried in gas making generations ago, and that they had failed to hold their ground as against horizontal settings. M. Coze showed that, by attending to certain points, not before so clearly distinguished, inclined retorts could be made to compare favourably with horizontal settings. This is his claim to fame.

At the same time, it would be a mistake to suppose that M. Coze has said the last word that can be found in favour of inclined retorts, or even to assume too unreservedly that the idea of inclining the retort, with any system of working, has yet thoroughly established itself. It is a good thing that the idea, in its various modifications, has been taken up by the engineers of important gas undertakings; for in the largest gas-works all advantages and defects of manufacturing systems and appliances are so magnified, that they force themselves on the attention as they rarely do in small establishments. Technical history is full of examples of inventions originated in small works, which have deluded their originators into the belief that they were valuable, simply because there was no scope for exhibiting them in full swing. In small works, moreover, the fond parent of a new appliance can look after it himself, and keep it from going wrong if it has a tendency that way. All this is changed when mouthpieces are to be counted by the hundred, and the actual handlers of plant are far away from the personal supervision of the responsible head of the establishment. With all the goodwill to new plant which has induced him to give it a trial, the manager of a large gas-works must test its performance by figures referring to uncontrollable facts, which exaggerate results that hardly betray themselves in a small factory.

All this being understood, it is a strong point in favour of the idea of sloping retorts that many gas managers in a very large way are attracted by it; but there is something equally striking in the fact that considerable diversity of opinion exists respecting the form which the idea should take in practice. Thus we have already the original Coze plan, and its modifications by Messrs. Morris, Van Vestraut, Trewby, Hunt, and Braidwood—only to mention those variations described or referred to in the Institution debate; and besides these there is the device of Mr. Kitt. A "captious critic" would say that so many attempts at improvement of the original idea are a poor compliment to its workability. This is a view that must be taken account of, for the number of apparently "captious" critics of a new manufacturing process is astonishing, and its partisans need all the patience they can muster in dealing with people who seem to take delight in finding excuses for *not* adopting a novelty; whereas, of course, the other side think that the statement of a few powerful reasons *for* the adoption should ensure this result. On the other hand, the numerous modifications and improvements may be adduced as evidence of the high intrinsic value of the central idea, and as representing the desire of so many men, working under different special conditions, to obtain the benefit of it for their own purposes.

It goes without saying, that if a retort is set at a sufficient slope, the labour of drawing the coke will be eliminated, inasmuch as the contents of the retort will fall out when the lower door is opened, and the charge disturbed from its position of repose. This result is to be attained at the cost, first, of a more expensive setting (although this consideration has been minimized by Messrs. Morris and Van Vestraut); and secondly, of an elaboration of the method of charging. During the Institution discussion, Mr. Goulden made a good point by claiming that the best and simplest retort-drawing machinery must be surpassed in convenience by the absence of all machinery. But if the complication of mechanism is removed from the drawer only to be added to the charger, where is the gain in the long run? We do not suggest that this is so in the case of the arrangement spoken of by Mr. Goulden, but only bring the argument forward as a possible reply to his own. As a matter of fact, we believe the plan devised by Mr. Trewby for getting coal to spread uniformly over the floor of a steeply-inclined retort is not at all complicated; but it may still be susceptible of improvement.

All these inclined retort systems, and the most elaborate systems of mechanical stoking for horizontal retorts, involve a good deal of expensive plant and fitments in the way of elevators, coal conveyors, hoppers, &c., which require to be worked constantly and on the grand scale in order to fully justify their cost. The retort-house, with its appurtenances, is, after all, an appanage of the retort, by which it is governed. Seeing the retort, one should be able to describe the house that it requires, with a little allowance for geographical conditions. Now, so far as has yet been seen, the inclined retort demands a good deal more of its housing than does the horizontal setting. Many, perhaps most, large gas-works have command of an elevated rail or tramway for their coal supply; but few get it so high as the inclined retort requires. It is a matter of choice how the coal is raised to the necessary elevation—whether by means of cranes, hydraulic hoists, elevators, or what not; but very considerable head-room is necessary, and the plant must cost a good deal of money. All this is proper for a large house intended to be kept practically in full work all the year round; but evidently the less idle time such houses know, the better they will pay. This is a serious consideration for all gas engineers, especially for such as cannot keep even one large retort-house in full work all the year round. Retorts, furnaces, houses, and connections must, of course, be laid up during a long summer in every gas-works; but when operated upon the simplest system, the only tools lying idle are a few shovels and wheelbarrows, which is a very different story to that of laying up machinery and machine tools worth as much as all the rest of the carbonizing plant.

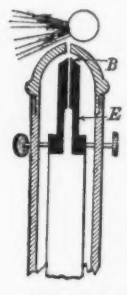
For this reason, although it is true that inclined retorts are cheaper to work than horizontal settings, is it not open to be said that this is only when the help of a good deal of subsidiary plant is taken into the account, which plant would "eat its head off" in the case of any retort-house not in constant, or nearly constant, employment? From the same line of consideration it follows that the day of cheap and efficient labour-saving machinery for working the commonest and cheapest horizontal retorts, is anything but eclipsed by the advent of the inclined retort and its accessory plant. The inclined retort will go far; but it will not go everywhere—at least in the lifetime of the present generation. It is even arguable that the prospects of such machinery as we have already referred to, for working horizontal retorts, are improved by the competition of the inclined retort. Here and there a manager, seeing his neighbour committed to some variety of inclined retort setting, will shake his head, and declare his preference for working retorts from the floor of the house, instead of making the men stand upon or over the benches; and he will be predisposed to look kindly upon any promising help from machinery. The "man with the shovel," without any sort of mechanism, will still "take a lot of beating," if judged as a stoking agent. Weight for weight, he is supremely efficient. But, unfortunately, he cannot always be relied upon to act either with the regularity of a machine or the reasonableness of a man; and as, come what may, gas must still be made, we have to supplement the man with something else.

Reference was made at the meeting to Mr. Foulis's hydraulic power stoker, which is quite a new machine. We believe that this device draws or charges a retort with about half a bucket of water; and that the operative portion costs but a trifle. One set of pumps, or source of power, can obviously be made to serve as many retort-houses as needed; and the value of the machinery lying by in summer would therefore be insignificant. Apparatus of which so much can be said is evidently deserving of exhaustive trial. In short, there is room for any number of attempts at a solution of the problem of carbonization; for the conditions under which it is presented in different places are so various that no one system can claim to fulfil all. The mere enumeration of the projects that have been advanced with this object would fill a column of the Journal; and their critical notice would tax the gas and mechanical engineering knowledge of any student. As Mr. Livesey said, the problem must now be solved; but not necessarily, or even preferably, in one way.

# NOTES.

### An Oxy-Hydrogen and Zirconium Burner

An oxy-hydrogen gas-burner, utilizing zirconium as the basis of the luminosity, is described by Herr G. P. Drossbach in the *ChemikerZeitung*. The general arrangement of such a burner is shown in the accompanying illustration, which represents an appliance that has worked for four years with good results. The inner tube brings the oxygen, and is reduced at its upper end by a cap E, perforated for about the length of a centimetre with a very fine outlet B. By means of three centreing-screws, this oxygen pipe is kept in the middle of the burner. The oxygen outlet is brought as close as possible to the outlet for the mixed gases, which is a millimetre in diameter. The outer tube conveys the hydrogen, which must have a pressure at this point 15 to 20 times less than that of the oxygen. With a consumption of 8¼ litres of oxygen per hour, a good flame is produced, which has its hottest point at 0·25 centimetre above the burner. This is therefore the place for the zirconium pencil, which is to be prepared in the following manner: A brass wire 4 or 5 millimetres in diameter is wound over with paper tightly glued down so as to make a thick hollow cylinder. This is to be closed with a stopper at one end, and filled with an 8 per cent. boric acid mixture of zircon in small portions, well packed down by means of wire and a wooden mallet. Four or five layers of the paper casing are unwound, and the pencil dried and baked. It is then hard and durable. The cost of the light—say, of 25 candles per burner—will mainly depend upon the cost of oxygen.




### Tests for White Lead and Turpentine.

Some quick and easy tests for white lead were recently given in the *Chemical Trade Journal*. The writer begins by remarking that the question of quality is governed to a considerable extent by the buyer's demand. If white lead is asked and paid for, carbonate of lead should be supplied, not a mixture of this with barytes or anything else. If, on the other hand, "white paint" is purchased, so long as the article sold answers the description, and is fair value for its price, it does not matter of what it is composed. When the purchaser demands white lead, and gives the proper price for it, he is justified in seeing that he gets this material in the purest state. Pure carbonate of lead ought to be completely soluble with effervescence in dilute pure nitric acid; any residue may be barytes, china clay, sulphate of lead, or gypsum. Only a small portion of the material to be tested, and plenty of the solvent, should be taken for tests of this kind. The solution, after adding sulphuric acid and filtering off the precipitated lead sulphate, should not give any further precipitate on adding, in succession, solutions of ammonium chloride, ammonium hydrate, ammonium sulphide (this gives a white precipitate if zinc is present), and ammonium oxalate, which will give a white precipitate if whiting or the carbonates of baryta and strontia are present. A sample of white lead which will stand these tests may be considered genuine. During recent years, various so-called patent white leads have come into the market. The basis of these is sulphate of lead, combined with lead oxide, zinc white, barytes, &c. Sometimes they are mixed with genuine white lead. When testing these with dilute nitric acid, little, if anything, dissolves. On boiling with strong hydrochloric acid, most of them completely dissolve; when the solution cools, crystals of lead chloride fall out; and if any residue remains, it is probably barytes. From the same source we obtain this quick test for spirits of turpentine, contributed by Mr. S. J. Hinsdale: Put 10 drops of the sample in a moderately concave watch-glass, and float it on a quart of water at a temperature of about 170° Fahr. If the spirit is pure, it will evaporate, and leave the glass quite dry, in seven minutes. If the spirit contains even 5 per cent. of petroleum (which is the usual adulterant), it will not completely evaporate in the time stated.

### The Case for Fuel Gas.

A statement of the actual position of the fuel gas question, as it is in the United States, has been made in the *Scientific American* by Mr. C. F. Prichard. This communication sums up the matter very concisely, and therefore forcibly. Mr. Prichard declares that fuel gas will never revolutionize the trade in heat, on account of the cost. He shows that if a householder burns 10 tons of coal during a winter season to heat his house, he will have had the benefit for this purpose of 260,000,000 heat-units. To obtain the same amount of heat from illuminating gas of 20-candle power, at 700 heat-units per cubic foot, would require 370,000 cubic feet; in the case of fuel gas, at 320 heat-units per cubic foot, it would require 812,000 cubic feet. With coal at $6 per ton, the cost of the heat would be $60, or (say) £12 sterling; with illuminating gas at $1 per 1000 cubic feet, the cost would be $370, or (say) £74; and with fuel gas at 50 c., it would be $406, or (say) £82. This computation assumes that the waste heat going to the chimney would be substantially the same in all cases, which is a rather wide assumption. Of course, if it is admitted that the effective duty of all three kinds of fuel is to be the same, the calculation must stand, and Mr. Prichard's deduction that "the extra cost is so excessive that no one seriously thinks of house heating or of steam-boiler heating by a distributed gas" is justified. Mr. Prichard goes on to state that if a householder wishes to boil 2 quarts of water, not less than 5 lbs. of coal would be consumed in the operation, from beginning to end, at a cost of about 1½d.; while 2 cubic feet of gas, costing 0·1d. would do the work much quicker, and with less expenditure of labour. Between these extremes, it is remarked, lie an infinite number of operations; the smaller ones showing a profit for gas, always with decreased labour. This percentage of profit gradually diminishes as larger quantities of heat are required, until no economy is shown, and the profit appears on the other side when the extreme is attained in continuous operations requiring large amounts of heat. Nothing new has been developed in fuel gas, unless it is the negation of commercial success in cities where it has been distributed. Even for manufacturing processes it shows but little economy, although it is a superior fuel to coal, and produces a better class of goods. Finally, it is confessed that "no proofs have been given that a unit of heat can be produced and distributed in the shape of any of the so-called fuel gases cheaper than by illuminating gas."

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**Mr. H. Lyne,** Engineer and Secretary of the Wexford Gas Company, has been selected, out of 30 applicants, to fill the position of Manager of the Carlow Gas-Works, in place of Mr. P. Gregan.

**Death of Mr. J. Sharp, of Great Wigston.**—We regret to announce the recent death, at the age of 58, of Mr. James Sharp, for many years Secretary of the Great Wigston Gas Company. A few weeks ago Mr. Sharp was attacked with influenza, which brought in its train pneumonia and bronchitis; and to these maladies he succumbed.

**"Smith's Tables and Memoranda."**—This collection of valuable information for engineers, architects, builders, surveyors, &c. (embodied in a convenient little book for the waistcoat pocket, and published by Messrs. Crosby Lockwood and Son), has now reached its fifth edition. The contents have been revised and extended; a new feature being a section devoted to electrical tables, formulæ, &c.

**Issue of Additional Capital by the Bromley and Lea Bridge Gas Companies.**—Investors who desire to obtain a holding in the two Surburban Gas Companies mentioned above will have an early opportunity of doing so, as additional capital is about to be issued by each. The Directors of the Bromley Company are inviting tenders for the purchase of 400 ordinary shares of the nominal value of £10; the offers for them to be sent in by the 20th prox. In the case of the Lea Bridge Company, the Directors have arranged for the sale of 1000 £10 shares, by Mr. Alfred Richards, at the Mart, Tokenhouse Yard, on June 22 (instead of the 28th inst., as formerly announced).

**Presentation to Mr. Alexander Duncanson.**—Last Saturday week, the engineers, officers, and workmen of the Liverpool Corporation Water Department, presented to Mr. A. Duncanson, on his retirement from the office of Deputy Water Engineer, after a service of 43 years, a beautiful silver afternoon tea service and salver. The chair was taken by Mr. John Evans, the Chief Clerk; and in asking Mr. Parry, the Water Engineer, to make the presentation on behalf of the subscribers, he informed the meeting that the gifts were spontaneously subscribed for by 365 servants of the department, from the engineers down to the humblest workman. Mr. Parry, in making the presentation, dwelt on the long and faithful services rendered by Mr. Duncanson, and expressed the hope that he would long be spared to enjoy the retirement which he had so well earned. Mr. Duncanson replied in suitable terms; and afterwards a gold diamond bracelet was handed to him for Miss Duncanson.

**The Dangers of Petroleum Storeage.**—In the course of the discussion at the meeting of the Incorporated Institution of Gas Engineers (reported elsewhere) on the use of oil gas as an enricher of coal gas, reference was made to the explosive nature of the vapour of petroleum, and the danger attending the conveyance of this oil; and the speaker (Mr. Lane) remarked that within the previous few days a petroleum vessel had been blown up. The vessel alluded to was evidently the *Tankerville*, which, while in the Newport (Mon.) Docks having her tanks fresh riveted and made secure after a voyage in which they had been strained, exploded about ten o'clock on the morning of Monday, the 11th inst., killing five men, and injuring several others. In consequence of the highly-inflammable character of the cargo carried, the danger arising from leakage and deposits of petroleum in varous parts of the hold, as well as the great risk from ignition of the gas given off by the oil, the utmost precaution was taken; but unfortunately the gas was fired, with the result above recorded. Mr. T. Canning, the Engineer and Manager of the Newport Gas Company, visited the scene immediately after the disaster, with the view of rendering assistance in removing accumulations of gas that might have taken place in the parts of the ship which were not destroyed. He was of opinion that the great heat of the sun in the early morning, pouring down upon an iron ship, readily vaporized any petroleum which remained about the tanks; and the gas coming in contact with the air, and having a spark of some kind applied to it, was ignited. What spark it was that caused the mischief—whether from a rivet, from a naked light, a pipe, or anything else—he, of course, could not say positively.

## COMMUNICATED ARTICLE.

### SOME EXPERIMENTS ON THE HEAT LOST BY RADIATION IN GAS-HEATED OVENS.

By Thos. Fletcher, F.C.S.

*Externally-Heated Ovens.*—Using an atmospheric burner, applied underneath, with the flame in contact with the metal, 1 cubic foot of gas per hour will heat 1 square foot of exposed surface 125° Fahr. over the temperature of the room. As an example, an oven of sheet iron, externally heated by a burner underneath, total outside surface 10 square feet, to be heated 250° over the temperature of the room, will require 20 feet of gas per hour.

*Internally-Heated Ovens.*—Experiments were made with an oven of sheet iron without non-conducting casing, flue outlets at the top, but turned downwards to one-half the height of the oven, to make the draught as far as possible self-adjusting. For every square foot of exposed external surface, 1 cubic foot of gas per hour, burnt inside in the usual way, will heat the oven 250° Fahr. over the temperature of the room = double the duty as compared with an externally-heated oven. *Example*: In a room at 60° Fahr., to heat an oven with an exposed black iron surface outside, to 310° Fahr. = 250° over the temperature of the room, an oven with 10 square feet external surface will require 10 cubic feet of gas per hour burnt inside; and an additional 10 cubic feet per hour will heat the oven 250° more = 560° Fahr. The rise in temperature is in exact proportion to the increase in the gas consumption. The internal capacity of the oven does not in any way affect the result.

*Jacketed Ovens Internally Heated.*—The same oven was jacketed with 1 inch thickness of slag wool on the sides and top; no other alteration being made. The average rise of temperature in the oven, was 430° Fahr. per cubic foot of gas burnt per hour for every square foot of external surface of the oven, including the bottom; and 10 cubic feet of gas which heated the unjacketed oven to 310°, after jacketing with slag wool heated it to 490°—the available duty being nearly doubled.

*Cooling Down of Jacketed Ovens.*—The same oven, after the gas was extinguished, with the flue left open, remained at 330° after 15 minutes, and 270° after 30 minutes. This shows that cooking will go on in a jacketed oven for a long period after the gas is extinguished.

The experiments were all made while no work was being done. The greatest proportion of the contents of an oven may be taken as water, which is the largest constituent of all food which requires cooking. If we take the average cooking temperature at 360°, the gas required to heat each pound of contents will be about half a cubic foot; and, in addition to this, we may take it as an average, that 15 per cent. of the water is evaporated, which will require approximately half a cubic foot more. The expenditure of heat in retaining the temperature of the contents may be ignored; there being no loss by radiation. We may therefore take it as a rule that, for each pound of food cooked in an oven, 1 cubic foot of gas is burnt, in addition to that necessary to retain the temperature, by loss from radiation and necessary ventilation, as shown by the experiments.

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**Midland Association of Gas Managers.**—The members of this Association had their usual excursion meeting last Thursday; the places visited being Leamington and Warwick. The arrangements made by the Committee for the delectation of their colleagues, as set out in the programme issued by the Honorary Secretary (Mr. J. S. Reeves, of Bilston), were ably carried out; and everything passed off well. The members assembled at the Leamington Gas-Works about eleven o'clock, and proceeded in conveyances to Warwick Castle—one of the most perfect specimens of Feudal architecture in England. After inspecting this, visits were paid, under the guidance of Mr. W. T. Tew, Engineer and Secretary of the Warwick Gas Company, to Leicester's Hospital and St. Mary's Church. In the afternoon the return journey to Leamington was made *viâ* Milverton and Binswood. On reaching the gas-works, some formal business was transacted, after which the members dined together at the Manor House Hotel.

**Presentations to Officials of the Cape Town Gas Company.**—On Saturday, the 25th ult., the employees of the Cape Town Gas Company presented three of the officers—the Manager (Mr. B. A. Lewis), the Secretary (Mr. F. Herbert), and the Collector (Mr. M. Versfield)—with mementoes of their pleasant connection with each other, which was about to be severed in consequence of the reconstruction of the Company. The men generally regarded this breaking up of the old associations as a loss to themselves; and they showed their practical sympathy and esteem for the gentlemen above named by asking each of them to accept a small gift, in the shape of a ring. The presentations were made by the former Chairman (Mr. Craynor), who, as one of the oldest shareholders, expressed regret at the separation, but assured the recipients that they had the best wishes of all who were there assembled. The gifts having been suitably acknowledged, cheers were given for the Chairman and the Manager, and the gathering dispersed. Mr. Lewis entered the Company's service under a special agreement, which has been somewhat abruptly terminated by the organization of the new undertaking.

## TECHNICAL RECORD.

### THE BUENOS AYRES CO-OPERATIVE GAS-WORKS.

Having, in the four preceding issues of the JOURNAL, given plans and descriptions of the general arrangements and the principal buildings comprising the above-named works, it only now remains to deal with the

*Gasholders and Tanks.*

The gasholders are two in number, in two lifts. The outer lift is 120 feet, and the inner lift 117 ft. 6 in. in diameter; each being 30 feet deep. On account of the expense of constructing brick or concrete tanks in South America, and, moreover, in ground in which the natural level of the water is only 4 feet from the surface, it was considered preferable to adopt iron tanks, the erection of which occupied much less time. The tanks were designed of annular form, in order to save the cost of excavating the hard "tosca" in the centre, and also for convenience in creating a framing to support the untrussed crowns of the holders. The pillars for supporting the columns of the guide-framing were also of cast iron, and were included in the specification of the tanks. The centres of the annulus were covered by concrete floors, on which were erected the framing for sustaining the crowns of the holders. These floors were 10 feet below the tops of the tanks; the whole surface being under water. The following particulars are taken from the specification:—

The tanks of the gasholders to be of cast iron, annular in form. Each tank to be composed of an outer wall 122 feet in diameter internally and 30 ft. 6 in. deep, and an inner wall 102 feet in diameter and 20 ft. 6 in. deep, and a bottom of cast iron between the two walls. The annulus to be 10 feet wide, and the inner wall to rise to within 10 feet of the top of the outer wall.

*Outer Walls.*—The outer walls of the tanks to consist of six rows of plates, each row being 5 feet deep, and containing 64 plates. The top row to be $\frac{7}{8}$ inch thick; the second row, 1 inch; the third row, $1\frac{1}{8}$ inches; the fourth row, $1\frac{1}{4}$ inches; the fifth row, $1\frac{3}{8}$ inches; and the sixth or bottom row, $1\frac{1}{2}$ inches. The upper horizontal and the vertical flanges of each row to be of the thickness of the plates themselves; and the lower horizontal flanges to be of the thickness of the plates next below them. The bottom row of plates to have flanges all $1\frac{1}{2}$ inches thick. The flanges to be strengthened by brackets 1 inch thick, placed at a distance of about 8 inches apart; and there shall be one bolt in each space between two brackets, a projecting fillet to be cast on the bottom and one side flange of each plate $\frac{3}{8}$ inch thick, and of the width of the thickness of the plates, to give space for caulking the joints. The bolts in the first and second rows of plates to be 1 inch in diameter; those in the third and fourth rows, $1\frac{1}{8}$ inches; and those in the fifth and sixth rows, $1\frac{1}{4}$ inches. There shall be twelve wrought-iron bands round the outer walls of the tanks, of 6 in. by $\frac{3}{4}$ in. flat iron, made in sixteen lengths, joined by jaws and keys, and tightened up in the usual manner. The bands to be situated at equal distances one from another, two bands on each row of plates.

*Inner Walls.*—The inner walls of the tanks to consist of four rows of plates of equal thickness with the corresponding row of plates in the outer walls, each to contain 64 plates. The flanges and the bolts to be of the same thickness and diameter as in the corresponding rows of the outer walls. The flanges of the inner walls to be on the inside of the annulus. The top row of plates shall have a flange cast on the outside, 18 inches from the top, 9 inches wide, and $1\frac{1}{2}$ inches thick, and supported by brackets as shown in the drawing. The ends of these flanges to be returned down, and to be bolted together with two 1-inch bolts and caulked.

*Bottom Plates.*—The bottoms of the tanks are to consist of two rows of plates, each 5 feet wide, exclusive of the external flanges. Each row to contain 64 plates, corresponding with those of the outer and inner walls of the tank. The outer edge of each row of plates to be turned up to meet the vertical walls for a height of 6 inches, and at the top of the return shall be cast the flanges to meet those of the bottom row of plates. The outer row to have also a bottom flange connected by brackets to the upper flange, to give strength and support under the outer wall of the tank; while the inner row shall terminate at the edge in a thickening-piece, as shown in the drawings. The two rows of bottom plates to be $1\frac{1}{2}$ inches thick, with flanges of the same thickness $3\frac{1}{2}$ inches deep, and bolted together with $1\frac{1}{4}$-inch bolts.

*Standards.*—There shall be 16 cast-iron standards arranged round the tanks, to support the columns of the gasholders. The standards to be of the form of rectangular cast-iron cylinders. The upper portion of each standard to be 10 feet long, and to have a moulded base and capital, and moulded panels in the sides. There shall be top and bottom flanges cast on the inside; the top flange being circular in plan, $1\frac{1}{2}$ inches thick, and having $2\frac{3}{4}$-inch holes cast in them for the holding-down bolts of the columns to pass through. It shall be strengthened by deep brackets cast on the inside, as shown in the detail drawing. In the middle of the casting shall be a second internal circular flange of the same thickness, and similarly strengthened with brackets, and having holes $2\frac{1}{4}$ inches in diameter, through which the holding-down bolts will pass, and

which will form the anchor-plate for these bolts. The bottom flange of the top section to be 3½ inches wide by 1¼ inches thick. The remaining portion of the standards to consist of three rectangular cylinders—two 5 feet long and one 5 ft. 5⅛ in. long—having internal flanges 1¼ inches thick by 3⅛ inches wide, bolted together with 1¼-inch bolts. There shall be base-plates 2 inches thick, bolted to the bottom of standards with 1¼-inch bolts, countersunk on the under side. The bottom flange of the standards to be external on three sides, and internal on the side next the tank. The faces of the flanges must be planed or turned in a lathe truly square with the vertical, and bolted together metal to metal without packing of any description. The standards to be secured to the tank by brackets cast on the tank plates, as shown in the detail drawing, and bolted by 1⅛-inch bolts.

One inlet and outlet pipe only, 24 inches in diameter, was put in for each holder; the arrangement of valves in the governor-house being such that the working is the same as if separate inlet and outlet pipes were provided.

The tanks were constructed on the "tosca" bottom, without intervening concrete; the "tosca" being first carefully levelled, and the bottom plates or floor of the annulus bedded on a thin layer of Montevidean sand, spread over the bottom to ensure their taking an equal bearing all over.

During the erection of the tanks, a 4-inch centrifugal pump was kept at work in a well sunk below the level of the bottom of the tanks, and situated midway between both of them and the tramway line shown on the general plan, and having adits communicating with the tank excavations. After the construction of the tanks was completed, the adits were closed, and the well utilized permanently for obtaining water for the works.

The concrete floor in the centre of each tank was 18 inches thick, and was rendered with 1 inch of cement and sand, and floated with pure cement. The framing for sustaining the crown of the gasholder consisted of cast-iron posts and wood rafters, struts, and purlins. The posts were made with a flat square base at the foot, and with sockets to take the struts; and at the top they had jaws to clasp the rafters and tie-bars. The posts were placed upon the concrete floor, but not attached to it, so that the rendering was not broken. The floor rested on the flange cast round the inside of the inner wall of the tank.

## OHIO GASLIGHT ASSOCIATION.

### The Annual Meeting at Zanesville.

(*Concluded from p.* 960.)

Mr. H. Wilkiemeyer read a paper entitled "In what direction should the Ohio Gas Companies look for the Future Cheapening of their Product?" Adoption of modern improvements, and displacement of old-fashioned apparatus, was the first "direction" considered. Many gas-works at present in operation kept obstinately to the old style of furnace, to imperfect condensation, and consequently costly or inefficient purification. In the distributing plant, there was still room for improvement, so as to enable a better and more satisfactory supply to be given at a lower initial pressure. But this was not sufficient. A thoroughly competent staff, presided over by effective, certain, skilled, and intelligent management, was equally necessary. The next thing was extension of trade; and, in this connection, energetic and systematic canvassing was recommended, together with liberal advertising. The uses of gas as fuel or for power were, the author said, by no means so well known as they ought to be. The paper concluded with advice to the managers of gas undertakings. They were urged to exercise more activity in advancing their profession, and to avoid undue mixing in politics and public business.

In the course of discussion, Mr. Fenn strongly supported the necessity for fresh energy in connection with the introduction of gas-stoves and gas-engines, and for advertising largely. He said he had himself followed such a course during the last few years, with marked advantage. Mr. Cline remarked that he went to a large expense in introducing gas-stoves. Shortly afterwards a natural gas company was established, who turned their speciality right into his stoves, and spoiled his business. Mr. Sherrard enlarged on the necessity for cultivating a good understanding with the customers, and treating them liberally; and he agreed that more good could be done outside than inside the Municipal Council. Mr. Harbison said that on this point there was room for some difference of opinion. In most cities there were two Boards—a Board of Aldermen and a Council; and, in his experience, a friend on either could do a great deal of good. He should have a clear understanding as to the object and circumstances of the company; and he could be of use in replying to unjust statements, and giving correct ideas on any point that came up. The public simply wanted to know the facts, to make them willing to support a properly-conducted gas company. By treating customers politely, and being fully prepared to advise them on every point, much trouble could be avoided. But the gas manager must first be thoroughly informed himself, and be willing to impart his information on every suitable occasion. Mr. Cantine drew attention to the necessity for insurance; to which the President replied that he found the rates asked so high that it was the practice at many gas-works not to insure.

Mr. G. H. Christian read a paper on "The Present Outlook for Manufactured Fuel Gas." In considering what is a fuel gas, he said that the heating power of one gas as compared with that of another was as the square of the heat-units divided by the product of the specific heat and weight of the products of combustion. He thus arrived at the following calculation:—

| | | | |
|---|---|---|---|
| 1000 cubic feet of natural gas | = | 1300 | c. ft. of coal gas. |
| ,, ,, | = | 1200 | ,, water gas carburetted. |
| ,, ,, | = | 2500 | ,, water gas. |
| ,, ,, | = | 8500 | ,, producer gas. |

In actual use, however, the natural gas, coal gas, and carburetted water gas required a large excess of air (fully 50 per cent.) for complete combustion; but water or producer gas could be burnt with a small excess—20 per cent. being ample. The loss of heat due to the excess of air rather altered the comparison. Of the manufactured gases available for small users, he thought either coal gas or carburetted water gas stood first; while plain water gas made a good second. There were two materials available to the practical gas maker—soft coal and crude oil; and he would say that all processes dependent upon any other basis than soft coal for fuel gas manufacture were not practicable on the large scale. According to the most reliable sources, 2000 lbs. of soft coal would yield 45,000 cubic feet of fuel gas, which at 360 heat-units per cubic foot represented 16 million units of heat. Taking the carbon in the coal at 1750 lbs., at 14,500 units per pound this would give 25½ million units. The efficiency of the gas was therefore about 64 per cent. In carburetted water gas, an efficiency as high as 70 per cent. could be shown; but that of coal gas could not be estimated on account of the residuals. Assuming all the coke to be converted into water gas, an efficiency of about 60 per cent. would be obtained. Carburetted water gas was therefore the best in point of efficiency. On the head of labour and repairs, he had made the following calculation:—

| | Average Cost per 1000 Cubic Feet. | Average Cost on an Equal Heat Basis. |
|---|---|---|
| Coal gas | 6½d. | 6½d. |
| Coal and water gas | 3¾ | 5 |
| Carburetted water gas | 3 | 3 |
| Water gas | 2½ | 4¾ |
| Coal and carburetted water gas | 2½ | 4 |

From this it appeared that carburetted water gas gave the lowest labour cost. The author went on to say that the cost of storeage and distributing plant was the most important item in connection with fuel gas, for which there would be sudden and varied demands. The richer gases were therefore placed at a great advantage as compared with the poorer.

Attention was next directed to the economy of gaseous as compared with solid fuels. Two boilers were run steadily for six months with nut coal. The duty obtained was 8·1 lbs. of water evaporated from 212° Fahr. per pound of coal, equivalent to 55 per cent. efficiency. Natural gas was used under the same boilers for four months; and 18,000 cubic feet of gas were found to be equal in heating effect to one ton of coal—showing an efficiency of 80 per cent. The author proceeded to show that in an ordinary domestic stove the result was very different; the efficiency being only 25 to 30 per cent. It had been found that in practice 20,000 cubic feet of natural gas were equal to a ton of coal, which only showed an efficiency of 33 per cent. Probably this low result was due to the large excess of air used, and supposed to be needed to secure complete combustion. Experiments were quoted showing the necessity for giving a proper supply of air to the heating-burner and also to the upper part of the flame, as the author had no doubt that a great deal of the gas used was not completely consumed. The waste in connection with the use of natural gas for domestic purposes was so great that it would ruin a manufactured gas business. Water gas was at considerable advantage from this reason: Its combustion must be complete; securing the full equivalent of heat, and a practical efficiency of 70 per cent. There was no reason for doubting the statement that in practice 20,000 cubic feet of water gas were equal to a ton of coal.

The public were clamorous for gaseous fuel, provided that the cost would not greatly exceed that of solid fuels. It was therefore desirable that gas companies should consider the advisability of offering gas at special rates for fuel purposes. Natural gas companies sold at 7½d. per 1000 cubic feet, of which about 3d. was expenses and the remainder profit. They should therefore be able to sell gas for fuel at 5d. per 1000 cubic feet profit above the actual cost. A fuel gas at 2s. per 1000 cubic feet would be so little in excess of the cost of coal, that its success might be taken as assured. The efficient working of a combined fuel and illuminating gas plant at Jackson (Mich.) was cited as a proof.

Discussion having been invited, the Secretary said he thought that when once natural gas was introduced in a district, it was a great educator in the use of gaseous fuel, and would prepare the way for artificial fuel gas. At the same time the author was right in saying that the wasteful use of fuel gas would prejudice the employment of the manufactured article. He might say that, in his town (Columbus), a natural gas supply had been commenced, and failed; and that, as soon as the natural gas stopped, his Company undertook the supplying of a limited number of houses with gas for fuel at 2s. 1d. per 1000 cubic feet. There was a large demand; but the appliances

used were not altogether satisfactory, and the experiment was not to be continued. He had concluded that the best way to heat a house economically with gas was to have a stove in each room. Mr. Christian said in his opinion the best way of distributing heat throughout a house would be by the medium of hot water or steam. The results he had quoted for natural gas showed a great efficiency in heating water. With steam still better results could be obtained.

The items in the question-box were next considered. Among others, the subject of the extent to which gas companies might be considered liable for damage by leakage or explosion was discussed at some length; and Mr. M'Ilhenny thought the lesson to be drawn was that it is better not to let any gas escape. Juries were apt to give verdicts against gas companies; and it was better to keep the gas in the pipes and sell it. Speaking on the subject of improvement in gas manufacture during the last three years, as compared with that of the incandescent light, Mr. Cantine did not think that anything of importance had been done with regard to either. The electric lights were cheaper; but this was to some extent attained at the expense of the quality. He looked on the incandescent electric light as a sort of "raiding" element, brought in by the manufacturers to compel someone to buy it; and the party who bought it would always regret the step, particularly when they tried to operate it in connection with gas-works. The President said it was generally known that the incandescent electric light was more costly, both to make and to use, than gas of corresponding illuminating value. It must also be remembered that gas suppliers had now more competition to meet. Arc lamps had come in largely for street lighting; and natural gas had made inroads on the fuel department. City councils were apt to lose sight of the fact that it was just in the profitable parts of the district that competition came in.

**Additional Scrubbing Plant for the Birmingham Gas-Works.**—Messrs. Kirkham, Hulett, and Chandler, Limited, have just received instructions from the Birmingham Corporation to supply a duplicate 5 million cubic feet per day "Standard" washer-scrubber, fitted with their recent improvements.

**The Supply of Coal to the Leeds Gas-Works.**—The principa business at the meeting of the Gas Committee of the Leeds Corporation last Thursday, was the opening of tenders for the supply of 260,000 tons of coal during the twelve months from June next. The prices showed a decrease ranging from 6d. to 1s. per ton, as compared with the quotations of last year.

**Cookery Lectures at Wood Green.**—Following up the successful lectures at Edmonton, &c., Mrs. Charles Marshall has given a four days' demonstration at the Masonic Hall, Wood Green, on behalf of Messrs. R. and A. Main, of Glasgow and London. Her interesting programme concluded last Friday evening by Mrs. Marshall preparing an invalid's diet; showing that a gas-stove is invaluable for sick-room cookery. Mr. Burton, the London representative of Messrs. R. and A. Main, was in attendance.

**The Electric Lighting Question at Barnsley.**—At the meeting of the Barnsley Town Council last Thursday, the minutes presented by the Park and Lighting Committee contained a recommendation to the effect that, in consequence of the withdrawal by the Westinghouse Electric Light Company of their tender, and the withdrawal of the Board of Trade of their sanction to overhead wires, and of the large increase thereby occasioned in the cost of supplying electricity to the borough, the consideration of the present scheme be adjourned; and that the Borough Surveyor be directed to prepare a scheme and plan for the supply of electricity to a smaller area, and submit the same to the consideration of the Committee as early as practicable. Alderman Blackburn said that the Lighting Committee had thrashed out the question thoroughly; and when they found that the Board of Trade interfered with regard to overhead wires, they decided not to go on with the scheme, and entail the extra expense. The Committee had felt the rebuffs they had received from the Board of Trade. If the Board had told them that they would have insisted on underground wires, they would not have proceeded in the matter. The estimated cost of the scheme with overhead wires was about £23,000; and with underground wires it would have been £33,000. After considerable discussion, the recommendation was adopted.

**Gas Exhibition at Tottenham.**—The Tottenham and Edmonton Gas Company have had apportioned to them a very large Room at Bruce Castle, in connection with the industrial and loan exhibition which is now being held there. The space has been well utilized by Mr. Broadberry, the Company's Manager, who has arranged a gas exhibition on a highly unique style. Messrs. Sugg and Co., Limited, have a very fine photometer at work, besides a large assortment of lamps, burners, gas-stoves, and other appliances. Messrs. T. Fletcher and Co. display their newest patterns in stoves and grillers. Messrs. R. and A. Main exhibit their cookers; as also do the Davis Gas-Stove Company, Limited, who have in addition an assortment of general bright goods. Messrs. Pontifex and Co., of Colman Street, exhibit some street lamps; and Messrs. T. Glover and Co. have three dry meters in glass cases which attract much attention. The same firm have also fixed a set of model gas apparatus — retort, condenser, purifier, and gasholder—with which Mr. H. O. Eldridge, the Inspector in charge, will at an early date make gas. Gas-burners of all descriptions are arranged by Messrs. G. Bray and Co., of Leeds; and coal tar products are shown by Messrs. Burt, Boulton, and Haywood. The lighting of the exhibition generally is accomplished by various lamps lent by the Thomas Lighting Company, Limited, Messrs. H. Greene and Sons, and Messrs. W. Sugg and Co. Twice daily the new cookery lecturer, Miss. A. L. Rotherham, demonstrates in an attractive manner; her style and delivery being exceptionally good. The exhibition will remain open till the end of June.

## CORRESPONDENCE.

*[We are not responsible for opinions expressed by correspondents.]*

### Working Exhausters with Gas-Engines.

We have received several letters in response to the request of a correspondent, referred to in the JOURNAL for the 12th inst. (p. 891), for information on the subject of driving an exhauster by a gas-engine; and we have pleasure in giving some extracts therefrom, which may be useful to many of our readers.

Mr. W. B. FEATHERSTONE, of Dundalk, says he has a 3½-horse power "Otto" gas-engine driving an exhauster. It has been in constant use for 14 years; and in the last half year it passed 15 million cubic feet of gas, and pumped from a well all the water required for a scrubber 40 feet high, as well as for the general work of the retort-house. The gas consumed was 257,000 cubic feet; the maximum quantity passed being 8000 cubic feet per hour under a 10-inch back pressure and a level gauge in the retort-house. Mr. Featherstone gives the following particulars: "I regulate the spur by lead weights on the governor of the engine. The exhausters are Dempster's horizontal double-cylinder, with 6-inch connections. The slides and exhaust-valve on the engine are cleaned once, sometimes twice, a week. The engine is stopped for a few minutes daily to oil the cranks; 40 gallons of oil lasting six months. The repairs are trifling, as every working wearable part we keep in duplicate; and an hour generally puts things right. No special man takes charge; but the men in the retort-house put on or take off a weight on the governor according to the make or to the retort-house gauge. I would advise your correspondent to get a gas-engine and look to it himself. When he is thorough master of every fault, and can tell by experience why it will suddenly stop or make peculiar noises, then teach his men what to do; and he will come to my opinion that they are very clever, beautiful, and wonderful machines—simple, cheap, and reliable. I do not believe ours costs us 1d. an hour; and, after 14 years, it is quite content to work or sleep out a Sunday, to spring instantly into life with a light from a match, a few turns of the fly-wheel, and a supply of gas as low as 12-candle power. It will soon let the stokers know, by loud blasts and snorts, if the gas is mixed with air. Connect a gas-engine with the inlet to the gasholder, and if the gas goes below 12-candle power, the engine snorts and kicks and stops, if the gas does not improve. It is a great tell-tale on sleepy stokers or gas getting poor."

Mr. J. NEWMAN, Manager and Secretary of the Sandown (I.W.) Gas Company, who has had nearly eight years experience with a gas-engine driving an exhauster dealing with a make of about 12 million cubic feet per annum, says he does not think any motor of this kind that he has seen is well adapted for this particular purpose. He considers the want of power to regulate the speed of the engine is a great drawback; as is also the accumulation of carbon in the cylinders. As far as his individual experience is concerned, he says the saving of labour, which was the principal inducement to the employment of gas in preference to steam power is *nil*. He considers it, indeed, greater than that of stoking. He therefore cannot recommend gas-engines for exhausting purposes, although he says he has seen them worked very advantageously for pumping and other operations.

Mr. T. GREAVES, Manager of the Melton Mowbray Gas-Works, says his exhauster, which passes 10,000 cubic feet of gas per hour, has been worked for twelve years with a gas-engine, and is doing very well. His make is about 20 millions. He thinks gas-engines quite as efficient for this purpose as steam; and he confesses to having a liking for them.

Mr. W. J. LATCHFORD, Secretary and Manager of the Broadstairs Gas Company, says that early in 1882 they fixed a gas-engine at his works, and ran one of Beale's exhausters, passing 5000 cubic feet of gas per hour, with a Fison's regulator; and it has been running most satisfactorily ever since. It also works a liquor-pump for the scrubber, and breaks all the coke that has to be broken. It is intended shortly to fix at the opposite end of the regulator an exhauster capable of passing 10,500 cubic feet of gas per hour. When they fixed the exhauster their make was about 12 millions; now it is upwards of 17 millions.

**Removing Iron from Water.**—A correspondent is desirous of hearing, through the medium of the JOURNAL, of a successful process for removing iron from water supplied to a house. In the case in question, the water is pumped daily from a well; and the iron is deposited in the boiler, and discolours the hot water supplied therefrom to baths and sinks, besides rapidly coating the boiler and any kettles or saucepans that may be used with the water. Our correspondent says it is easy to make suggestions for removing the iron; but he is anxious to hear of some process already in use.

**The Testing of Gas at Birmingham.**—At the meeting of the Birmingham City Council to-day, the members will consider a recommendation that Dr. W. A. Tilden be appointed Examiner, for the purpose of securing independent tests of the gas distributed from the Corporation Gas-Works, for one year, at a salary of £200.

**Long Eaton Water Supply.**—Last Wednesday, Colonel J. O. Hasted, R.E., one of the Inspectors under the Local Government Board, held an inquiry at Long Eaton relative to the application of the Local Board for sanction to borrow £20,000 for purposes of water supply. Mr. Hodson, C.E., gave details of the scheme. The well, he said, was completed; but owing to the geological formation, the work had cost more than the estimated sum. He hoped, however, to save £1000 on the contract for machinery. The estimate was raised to £38,201 to supply Melbourne and Castle Donington; and he had allowed for the places developing, calculating the population at eventually 28,000. The total estimate for the scheme was £39,767; and the Board required some assurance that the whole sum would be granted before borrowing the £20,000 asked for. The Inspector suggested it would be better to apply for the whole sum at once; and at a meeting of the Local Board subsequently, it was decided to alter the resolution, and apply for sanction to borrow £38,500.

# PARLIAMENTARY INTELLIGENCE.

## PROCEEDINGS ON GAS, WATER, &c., BILLS.

Down to the rising of the Houses for the Whitsun recess, the following progress had been made with Bills relating to the supply of Gas and Water :—

Bills Royal Assented: Leighton Buzzard Gas Bill; Llanelly Local Board Water Bill; Market Drayton Water Bill; Mountain Ash Local Board Bill.

Lords Bills passed, and sent to the Commons: Alloa Water Bill; Bristol Gas Bill; Dundee Water Bill; Filey Water and Gas Bill; Glasgow Corporation Bill; Kettering Gas Bill; Llanelly Water Bill; Malvern Water Bill; Newark Corporation Bill; Northallerton Water Bill; Troon Water Bill.

Commons Bills passed, and sent to the Lords: Barmouth Local Board Bill; Bognor Water Bill; Falmouth Water Bill; Fylde Water Bill; Garw and Ogmore Gas Bill; Penmaenmawr Local Board Bill; Rhyl Gas Bill; Stourbridge Gas Bill; Stourbridge Improvement Commissioners' Bill; Sunderland and South Shields Water Bill; Western Valleys (Mon.) Water Bill.

The following progress has been made since our last report :—

Lords: Barmouth Local Board Bill and Rhyl Gas Bill, read a second time; Sunderland and South Shields Water Bill, read the third time and passed.

Commons: Electric Lighting Provisional Orders Bill (No. 12), to confirm Provisional Orders relating to Leeds and Newcastle-upon-Tyne, read the first time; Alloa Water Bill, read a second time and committed; Southwark and Vauxhall Water Bill, reported; Electric Lighting Bills (Nos. 1, 2, 3, and 4) and the Filey Water and Gas Bill, read the third time and passed.

Petitions against the following Bills have been presented :—

Glasgow Corporation Bill, from the Magistrates and Commissioners of Police of Govan and A. B. Allan.

Northallerton Water Bill, from Thirsk District Water Company.

## THE METROPOLITAN WATER SUPPLY INQUIRY.

### Sixth Day—Tuesday, May 12.

(*Before Sir* MATTHEW WHITE RIDLEY, *Chairman; Mr.* T. H. BOLTON, *Sir* ALGERNON BORTHWICK, *Mr.* BRISTOWE, *Mr.* H. W. LAWSON, *Mr.* J. W. LOWTHER, *Mr.* MURDOCH, *and Mr.* ROWNTREE.)

SOUTHWARK AND VAUXHALL WATER BILL.

According to arrangement, the Committee on assembling to-day commenced the consideration of the Bill of the Southwark and Vauxhall Water Company, the object of which is to authorize the raising of further capital to the extent of £300,000 for carrying out additional works at Streatham, Nunhead, and Hampton. The Local Government Board had issued a special report upon the Bill, for the guidance of the Committee; and this came before them. In the course of it, the Board made the following remarks :—

The Board have no doubt that considerable expenditure is required both for the improvement of the supply in districts already served by the Company, and for its extension to new houses, of which some 1600 are annually added to the Company's district. It is to be noticed, however, that although the number of houses supplied has risen from 90,535 in 1880 to 111,155 in 1889, and the estimated population from 672,677 to 825,886, the average daily supply of water has actually fallen from 23,985,827 gallons in 1880 to 23,591,919 gallons in 1889; and the Board have received complaints that in various districts in which the Company have undertaken to give a constant supply, and have put the owners of property to the expense of special fittings, the supply is, in effect, intermittent and insufficient. The Board have repeatedly urged the Company to proceed with the execution of the structural works which are necessary to enable them to maintain a proper supply; but hitherto comparatively little progress has been made, though the more profitable work of extending supplies to new houses has proceeded rapidly. The Board suggest, therefore, that the Committee should require from the Company detailed particulars of (*a*) the storeage and subsidence reservoirs, and (*b*) the new filter-beds which, according to the preamble, it is proposed to construct, and should specially allocate an adequate part of the proposed capital to those works. The Board also direct the attention of the Committee to the clause [19] for establishing a sinking fund "for the purpose of purchasing and extinguishing the share capital of the Company." This clause, the Board submit, is practically of very small effect; and they think it desirable that the Committee should consider whether it is not reasonable that, when a Company applies to Parliament for authority to increase its capital, provision should be made for giving the public a larger share in the resulting profits.

Mr. BIDDER, Q.C., in opening the case for the promoters, said the Bill had no relation to the main subject before the Committee, and did not involve any question of principle, but asked for the authorization of capital expenditure absolutely required for matters of special urgency; the supply of water which the Company were giving at the present time being from 25 to 26 million gallons daily for a largely-increasing population. In tracing the history of the Company, the learned Counsel said that in 1884 the capital expenditure and financial position of the Company were under the review of Parliament, and were ratified and confirmed. In 1886 they found it necessary to go again to Parliament for further capital powers; and they were then authorized to raise £300,000 under the auction clauses, and a provision, which was then new, was inserted for creating a sinking fund. At the beginning of the present year, something like £224,000 of this amount had been actually spent; and the Chairman and the Engineer of the Company were prepared to render the strictest account of every penny of that expenditure. The Company were now in this position: They had a rapidly-growing district, and a constant demand upon them for extensions, which they were bound to make, and certain other causes for expenditure; but they were absolutely at the end of their money powers. The annual capital expenditure in the necessary extensions of mains was between £8000 and £9000; and if they only looked forward some five or six years, they must have £50,000 or £60,000 for this alone. With regard to the filter-beds at Hampton, the Local Government Board had, for some time past, been pressing the Company for an increase of the area; and the Bill now before the Committee proposed to provide it. The Company also intended to construct further reservoirs at Nunhead, which were of great importance for maintaining and ensuring a supply of water, and especially under circumstances such as those of the recent exceptional season. The expenditure upon the latter item would be £100,000. Then at Streatham the Company had obtained land, and had sunk a well, which had been a great success as far as finding water was concerned, as they reckoned upon getting from it an addition of something like 4 million gallons. In order to bring this supply into operation, filter-beds and other works would be needed, which it was calculated would cost about £40,000. It was also necessary to provide an increase of pumping power at Hampton, which would entail a further expenditure of £50,000; and there was also an item of £20,000 to carry out certain works to complete the high-pressure system. The whole of this would be wanted in a very few years; and a considerable part of it should be laid out immediately. Unless it was spent, the Company would find themselves unable to discharge their obligations; and the increasing population of their district would suffer. Referring to the report of the Local Government Board upon the Bill, the learned Counsel said it was perfectly true that, while the number of houses had increased, the daily supply had decreased; but the reason was that the Company had been actively engaged in introducing the constant supply, and had now brought it to 76 per cent. of the entire supply. In doing this, they had to adopt special means to prevent waste and leakage; and it was this that had resulted in the diminution of the quantity of water required by the district. Then the report said: "The Board have received complaints that in various districts in which the Company have undertaken to give a constant supply, and have put the owners of property to the expense of special fittings, the supply is, in effect, intermittent and insufficient." He thought they had a good deal to complain of in the Committee-rooms of a gentleman unknown sitting in a back chamber of the Local Government Board, who, with imperfect knowledge, wrote such reports, and scattered broadcast imputations, and whom they could not bring face to face with them. He wished someone would come from the Local Government Board and say what that paragraph meant, and what foundation there was for it, because he was instructed that it was absolutely without foundation.

Mr. BRISTOWE remarked that the report was signed.

Mr. BIDDER admitted that Sir Hugh Owen's name was appended to it. But Sir Hugh Owen was, he said, Secretary of the Local Government Board; and though he signed the report, he did not write it.

The CHAIRMAN: He is responsible for it.

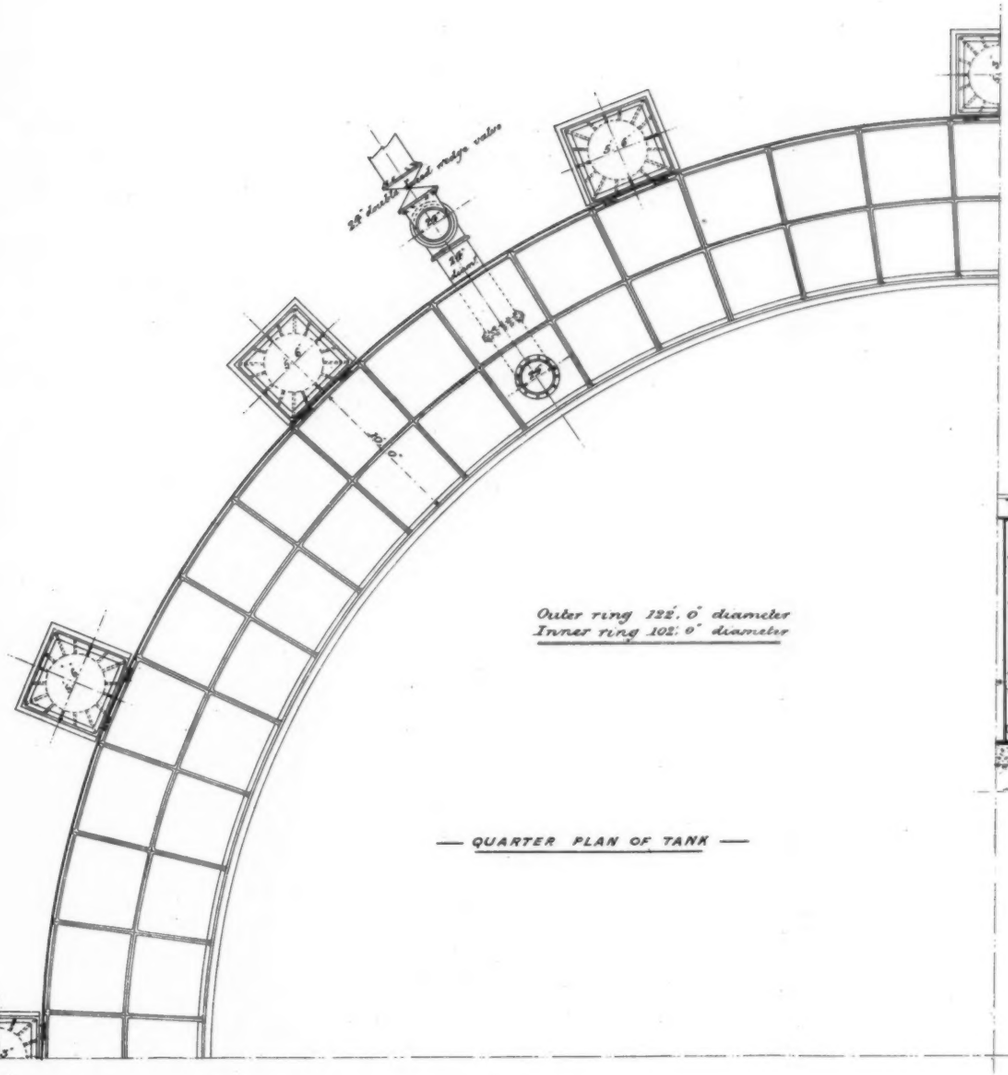
Mr. BIDDER said that "officially" he was responsible; but he was quite sure the Chairman knew the difference between official responsibility and the personal responsibility for the statements contained in the report. He only wished he could have that gentleman whoever he was in the witness's chair for a quarter of an hour. The learned Counsel then proceeded to deal with the London County Council's petition against the Bill, and said that he did not know whether or not anyone wished to impugn the quantity or the quality of the Company's supply; but, if so, they were prepared to defend it by the highest scientific evidence, and to show that it was quite above suspicion. He asked if the County Council really suggested that, because the water question was looming in the future, people who were building new houses at Wandsworth and Streatham were to go without water, for, in a few months, unless the Bill was passed, the Company would not have the means of extending their supply.

Sir *H. Knight* was then examined by Mr. BIDDER. He said he had been for 15 years a Director, and for about 13 years Chairman of the Company, which was formed in 1845 by an amalgamation of the Southwark Company and the Vauxhall Company. In 1852 under the General Act, they removed their intakes to Hampton above the tideway of the River Thames. In 1856 they were applied to by the occupants of certain portions of Wimbledon for a supply of water. This portion of Wimbledon was in straits for water, owing to the fact that the Lambeth Company, who had parliamentary powers to serve Wimbledon (which was outside the Southwark and Vauxhall Company's district), had not a sufficient head of water to enable them to reach those high grounds. But the Southwark and Vauxhall Company had; and therefore an agreement was entered into between the two Companies that the Southwark Company should supply a portion of Wimbledon above a certain level. For the purpose of affording this supply, they put up engines and laid the necessary mains. Their district extended from Deptford and Southwark in one direction to Petersham in the other; and from the River Thames on the north to Streatham and parts of Wimbledon on the south. In 1884, after an inquiry before Parliament, they were authorized to take within their limits those districts of Wimbledon which they had previously been serving without statutory powers; or, rather, those districts were confirmed to them. In 1886 they applied to Parliament for the purpose of getting authority to raise the £300,000 additional capital to which Mr. Bidder had referred, and which they were empowered to raise subject to the sinking fund clauses. Before they were allowed to raise this money, they laid before Parliament the purposes for which it was required. As to one portion of it, certain works were detailed and put before Parliament as the works which would have to be executed; and as to another portion, it was for the general purposes of the undertaking. As regarded the whole of this expenditure, he had before him figures which showed that every penny of the money had been laid out with perfect accuracy to the pledges that had been given. They had a special expenditure which was required for extensions, &c.; and they were under statutory obligations to supply houses wherever required. But not a single yard of the mains had been laid outside those obligations. Under their Act of 1886, they were empowered to insert outside the houses stopcocks in boxes, for the purpose partly of enabling them to detect and check waste. The use of these boxes, coupled with other precautions and other influences which they had brought to bear, had enabled the Company to stop waste to an enormous extent. Their authorized

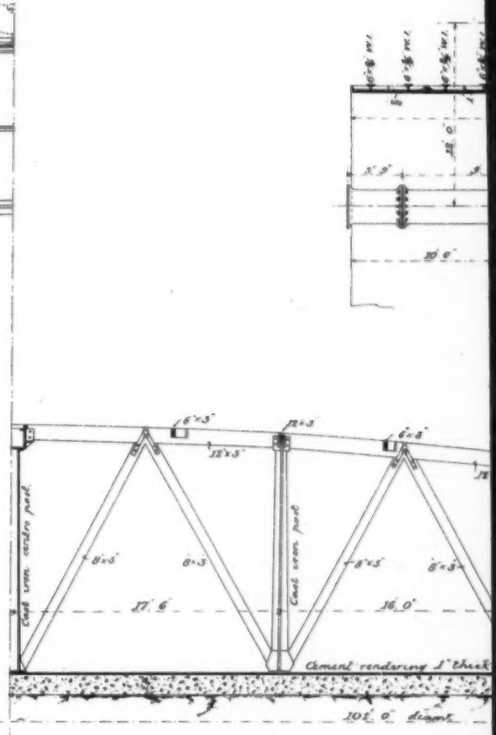
# BUENOS AYRES CO-OPERATIVE GAS WORK

## GASHOLDER TANK 122 FEET DIAMETER & APPENDAGES

*Scale in Feet.*




— QUARTER PLAN OF TANK —



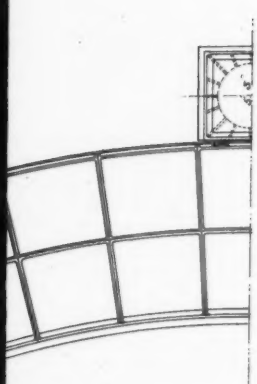

— HALF SECTION OF TANK —

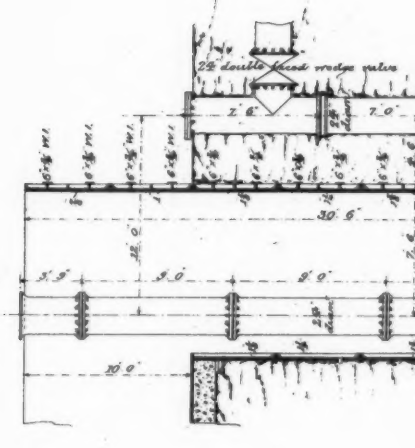
HILL & SHILTON, PHOTO LITHOS, 12, COUGH SQUARE, & 4, BOLT COURT, LONDON, E.C.

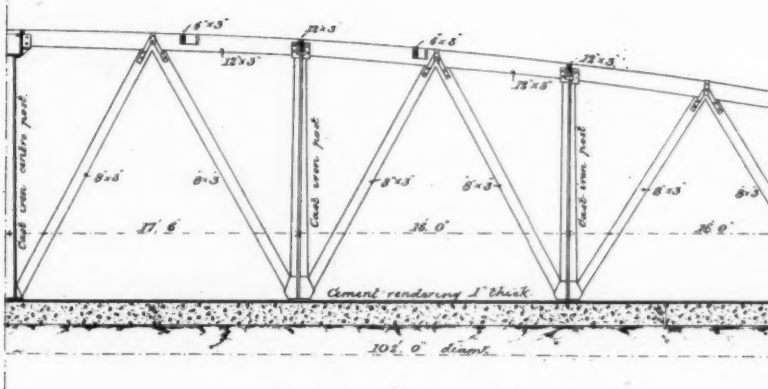
# RES CO-OPERATIVE GAS WORKS

## R TANK 122 FEET DIAMETER & APPENDAGES

*Scale in Feet.*



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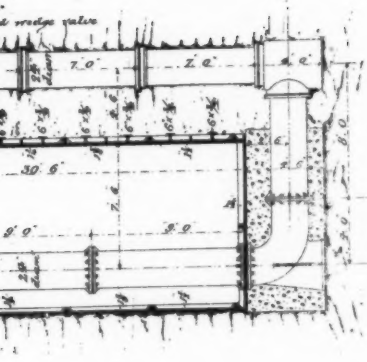
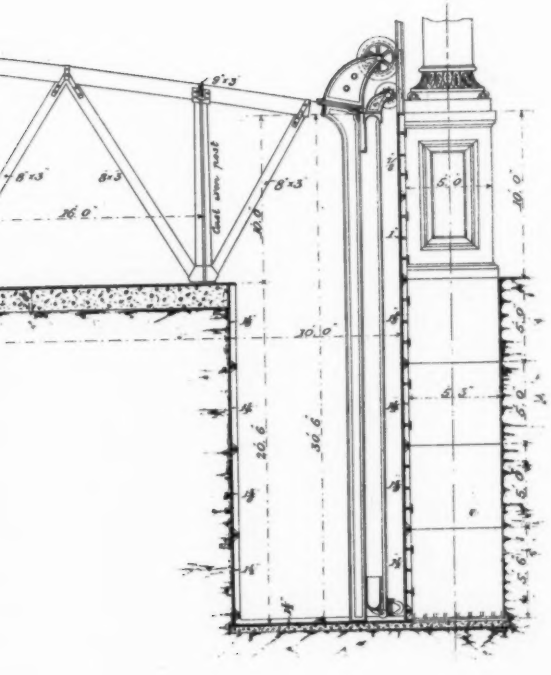


— INLET & OUTLET PIPE —



G. E. STEVENSON, Engineer.

capital of £2,300,000 had been wholly issued. It was made up as follows: Ordinary stock entitled to a maximum dividend of 10 per cent., £902,300; 1265 class "D" shares, entitled to a maximum dividend of 7½ per cent., £126,500; and 5 per cent. preference stock £489,200. There were also three debenture stocks—£391,649 at 4 per cent., £94,316 at 4½ per cent., and £260,695 at 4½ per cent.—making a total of £746,630 of debenture stock, which made a total of the ordinary stock, the "D" shares, and the debenture stock, of £2,264,630. If the premiums on the debenture stock issued under the Act of 1886, which came to £35,370, were added to that, it would make the total £2,300,000. This £35,370 bore no interest and carried no dividend. The amount of capital expended up to last year was £2,232,195; and the gross revenue for the year was £213,045; the net profit being £121,347. Since Sept. 30, 1890, the payments made for works in progress, together with the liabilities which the Company had had to meet would use up the whole of the unexpended balance. From 1845 to the end of 1851, the dividend on the ordinary stock was 5 per cent.; then between 1851 and 1854, it fell to 4 and 4½ per cent.; and from that time to 1858, it was 5 per cent. In 1860 it rose to 5½ per cent.; and up to 1871 it fluctuated between 6 and 6½ per cent. From 1877 to 1879 there was a falling off, after which it again rose to 6 per cent., and now stood at 7 per cent. The debenture stocks consisted of 4, 4½, and 4½ per cents., amounting to £55,864.

Mr. BIDDER: With reference to the filtration works at Hampton, I believe your Board have not entertained quite the same view that the Local Government Board take; but you considered that you could not lightly disregard the representations made by the Board.

*Witness:* No; representations coming from such a n authority must demand the very best attention. I do not know that there is any difference of opinion, except in this—that the Local Government Board seemed to be under the impression that filtration works were immediately necessary; and the Company (knowing exactly what the quality of the water delivered is, and what capacities they have) ventured to tell the Board that there was no immediate hurry, and that there was plenty of time to consider all the circumstances and to carry out the works in the best possible manner.

Examination continued: The water was analyzed daily by Dr. C. Meymott Tidy, Dr. Odling, and Professor Crookes; and the Company had not a penny with which to carry out the works required by the Local Government Board. Having given details of the expenditure of the £300,000 authorized by the Act of 1886, witness proceeded to furnish the particulars as to the manner in which the £300,000 now proposed to be raised was to be spent, as follows: For additional filters at Hampton, £33,000; statutory main requirements for five years, £50,000; three additional storeage reservoirs at Nunhead, £100,000; additional engine power at Hampton or elsewhere, £50,000; for completion of works at the Streatham well, to render the supply available, £40,000; and for the completion of the high-pressure service, £20,000. In regard to the latter item, he explained that people were now building higher houses; and in order to reach the tops of these houses, they would have to put such an enormous pressure upon the mains supplying the lower districts, that they would blow all the fittings to pieces. It was therefore absolutely necessary to lay an additional line of mains to carry water at very great pressure to serve these high places.

Mr. BRISTOWE: Workmen's dwellings, and buildings of that sort?

*Witness* said yes. Referring to the petition of the London County Council, he stated that none of the works proposed were renewals of obsolete or defective existing works, but were all new works. With regard to the report of the Local Government Board, which stated that, though the population had risen between 1880 and 1889, there was a falling off in the quantity of water supplied by the Company, he explained that 76 per cent. of the district was now under constant service, which had put a stop to an enormous amount of waste and leakage. Then there were other sources which had enabled the Company to detect waste in all sorts of directions; in fact, the figures went for nothing as regarded the point whether the consumer had as much water now as he did previously, because they took no account of a dry season, when an extraordinary quantity was wanted for manufacturing purposes and road watering. But he was convinced that the consumer had quite as much water now for domestic purposes as he ever had before, if he had not even more. With regard to the complaints which the Local Government Board said they had received as to the supply being intermittent and insufficient instead of constant, he knew the statement to be utterly unfounded. The Directors had only received four complaints from the Local Government Board in five years; and these were all fairly met, answered, and dealt with. That represented only one complaint for 112,000 houses supplied every day for a whole year. A record was kept of individual complaints, and it showed that the average during the past six years did not exceed 1200, or about three complaints per day; and of these 89 per cent. were shown to be due to defect in the consumers' own fittings. Witness then entered into an elaborate explanation of the sinking fund clause.

Cross-examined by Mr. FREEMAN (for the London County Council): They were not proposing to construct any subsidence reservoir, as he thought they could do a great deal better with their lateral filtration system. With reference to the new filter-beds at Hampton, the quality of the water at present produced showed that these new works were not absolutely necessary; but the Local Government Board thought circumstances might arise, and that it was better to protect the water by a second filtration. He considered they ought, in supplying water, to put themselves beyond doubt as to quality; and when such an authority as the Local Government Board required the water to be filtered a second time, he bowed to the authority, and thought it as well to carry out their wish. By agreement with the Thames Conservancy, the Company were entitled to take 24½ million gallons of water daily from the Thames. He did not think that the intakes were situated in the parish of Staines, but in Hampton. The report of Dr. Drysdale to the Local Government Board with reference to the area had not been brought to his attention, nor had he heard that charges had been recently brought against that particular district as being so polluted with sewage as to be totally unfit for use by the Water Companies; but if he had heard of such a thing, he would have known, from absolute experience, that it was utterly unfounded. There was a magnificent gravel bed, 20 feet thick, extending for miles, with not the slightest chance of pollution coming into it. It was one of those nonsensical expressions paraded before the public for heroic purposes generally.

Mr. FREEMAN: Now, would you point out with reference to any of the works proposed, except the mains required for next year's distribution, what harm would be done to your Company by having to wait for another twelve months till the bigger question which involves you and all the other Companies is settled?

*Witness:* Very serious harm might ensue, because the "bigger question" might not be settled; and it would be no excuse for the Company, if they failed in their duty, to come to Parliament and say that they had failed because they depended on the "bigger question" being settled. The reply would naturally be: "That was not your business; you ought to have taken care that you were safe."

Would you have any objection, as this money is required for the immediate purposes of your works, to a clause being put into the Bill to secure that it should be paid at par by certain instalments—that the money should be lent you by one of the public authorities, and repaid by annual instalments?—Most certainly I should. I never heard such a suggestion in my life.

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**Seventh Day—Wednesday, May 13.**

On the re-assembling of the Committee to-day,

Mr. BALFOUR BROWNE, on behalf of the Thames Conservancy, who, he said, were not concerned in the Bill under consideration, called attention to the suggestions made by Mr. Freeman as to the condition of the Thames water at Staines. The Conservators were responsible for the purity of the water, and had a complete answer to the allegations respecting it; but he protested against the matter being gone into on this Bill, as the Conservancy Board were not represented. He invited the Committee to deal with it at the proper time, under the instructions they had received from the House to inquire as to the sources of supply and other matters, but not to do so until they had the right parties before them.

The CHAIRMAN said if the Committee inquired into the question of the purity of the water, they would take care that opportunity was given to the Thames Conservancy to have it thoroughly investigated; but in the case of this particular Bill, he did not think they would be guided by the question of the purity or non-purity of the water.

Mr. BALFOUR BROWNE expressed himself as perfectly satisfied with that declaration.

Mr. BAGGALLAY (for the promoters) said they were taken very much by surprise when the question of the purity of the Thames was raised on the previous day, because the petition of the County Council did not deal with the subject of the purity of the Thames at all. He did not know if they would be expected to call evidence on this matter, as they knew that it would be gone into on the other Bill.

The CHAIRMAN said he did not think they would.

Mr. FREEMAN remarked that as the point had been raised, the reason he had put the question he did to Sir H. Knight was that, the Bill being one to authorize the raising of money for works, and some of those works being for filtration purposes, he wanted to know what those purposes were.

The CHAIRMAN stated that, in view of the report of the Local Government Board, and in consequence of the comments and evidence with respect to it, the Committee thought it would be desirable that some questions should be put to the officials of the Board; and he had accordingly desired their presence that day. Both Major-General Scott and Mr. Stoneham (the Official Water Examiner and the Official Auditor under the Metropolis Water Act, 1871) were present; and the Committee proposed to examine them as to the complaints which had been made to the Board, and also about the sinking fund.

Mr. *A. Stoneham* was then examined by the CHAIRMAN. He said he was responsible for the statement in the report that the sinking fund clause was practically of small effect, and that it was desirable that the Committee should consider whether it was not reasonable that when a Water Company applied to Parliament for authority to increase their capital, provision should be made for giving the public a larger share in the resulting profits. By this he meant that, under their last Act, the Company raised £200,000 on debenture stock at 4 per cent.; that their average earnings, as shown by the latest published accounts, were 5·14 per cent.; and that while only £350 would be carried to the sinking fund, £5070 would be carried to the profit fund. He thought the whole of the premiums should be allocated to the sinking fund, and be re-invested from time to time.

Mr. BIDDER said he did not desire to cross-examine Mr. Stoneham; but he would like to ask him if he was aware that the share capital of the Company, if it was contemplated investing in it for the purpose of the sinking fund, and if they went into the market place and bought it, did not return more than 3½ per cent.

*Witness:* Yes, I think so; or 3½ per cent.

So that it would be a worse, and not a better, financial operation?—I am not dealing with the financial operation. The dominant idea of the Committee who settled the clause no doubt was that there should be a sinking fund, and that the sinking fund should extinguish the capital of the Company.

Major-General *A. De Courcy Scott* was examined by the CHAIRMAN. With reference to the complaints, referred to in the report, as to an intermittent and insufficient supply of water being given instead of a constant supply, he said that such complaints had been made to the Local Government Board by the Guardians of St. Olave, Bermondsey, the Wimbledon Local Board, and the London County Council. In the case of the St. Olave's Union, he visited the spot, and also conferred with the Engineer of the Corporation, and suggested that, to avoid complications, they should agree as to certain facts; that is to say, that they should, in conjunction, take the pressures, and ascertain what they were in the pipes which supplied the building. The conclusion he came to was that the pressures were insufficient to supply water at all times. This was due either to deficiency of pumping power or of main capacity; he could not say which.

Mr. BRISTOWE said he understood that at one time the difficulty was removed by turning on the water from the mains from Nunhead; and he asked whether, if the additional reservoirs at Nunhead were made,

the Companies would or would not be better able to furnish Rotherhithe and the district with a constant supply of water.

*Witness* said the reservoirs at Nunhead would most distinctly improve it; and the proposal of the Bill in this respect met with his approval. In the case of the complaint by the Wimbledon Local Board, that Board appealed to the Local Government Board to put pressure on the Company to make them furnish a constant supply to the district. There were complaints from individual householders and from the Board; the latter stating that the pressure was so low that it took a considerable time to fill the water-carts.

By Mr. BIDDER: The Company's Engineer had stated that the fittings of the Local Board were too small to supply the water-carts rapidly; but he (witness) did not concur in this at all.

By the CHAIRMAN; The complaint of the London County Council was with reference to the supply to the upper floor of a block of buildings in Tooley Street. He called upon the District Board, and gathered from them that they considered the evidence in support of the complaint neither satisfactory nor conclusive, because assertions that there was scarcity of water at times, made by the occupants of some of the tenements, was contradicted by occupants of adjoining tenements. He went to the place with the Medical Officer of Health, who complained that his own house close by was badly served, and that the service was so deficient that he had to use his bath to retain a proper quantity of water; and the conclusion he (witness) came to was that some defect existed, and that the supply was not a constant one. He considered that there had been unnecessary delay in the construction of works for maintaining a proper service, more especially in connection with the filtration works. The supply from the Southwark and Vauxhall Company's station at Hampton reached 11 million gallons in the summer; and he thought the filtering appliances there ought to be improved. He was responsible for the suggestion in the report that particulars should be given of each of the works mentioned in the Bill, and the special capital allocated to them.

The CHAIRMAN: Has there been any previous complaint, within your knowledge, of the Company not having used the money which had been granted them by Parliament for the purposes for which it had been sanctioned?

*Witness* said he was not aware of any; but he considered that, as security for the construction of those works which were so essentially necessary, there ought to be some specific appropriation for the purpose, so that the Company might be compelled to use for filters the money appropriated to filters.

In answer to further questions, witness said, with regard to the Streatham well, the cylinders were just about the bottom of the Thanet Sands, which were very fine—almost of the consistency of flour. He understood that there was a gap between the cylinder and the chalk, the consequence of which was that the water, when pumped, carried with it a certain quantity of sand which created turbidity. If this pumping of sand continued indefinitely, there was a distinct danger to the permanence of the well. Such incidents had been known as pumping out the subsoil all round a well, with the result that the chimney of the engine-house began to lean from the perpendicular, cracks appeared in the engine-house, and the sides of the well began to show signs of failure. It ought to be carefully ascertained whether or not this sort of thing was going on, before the money was expended on the well.

Mr. BIDDER called attention to a paragraph contained in witness's report on the Streatham well, in which he stated as follows:

> The evidence given in regard to the results of analyses of the samples shows that the water contains but a very minute proportion of organic matter; that it is slightly softer than the Thames water as delivered by the Companies to London; that about 80 per cent. of the hardness is removed by boiling; and that it has no appreciable effect on lead after 24 hours' contact. Considered organically, the water is of high quality . . . . The turbidity is, no doubt, caused by the presence of aluminous matter; and in order to render the water suitable for table use, it would have to be treated by subsidence and decantation or filtration, or be softened by Clark's process, either one of which modes of treatment would, no doubt, render it equal in appearance to the best of the waters ordinarily supplied to the Metropolis.

*Witness* expressed the opinion that it was to be regretted that the question of subsiding reservoirs had not been taken up, and that some provision for them had not been made in the Bill, because it had been repeatedly stated that the Company were deficient in such reservoirs. In regard to the Company's water, he stated in his report for January last that the results of the analyses placed it the highest among the Companies. It was only on the special occasions when the river was in a bad condition that the absence of subsiding reservoirs with small filters began to tell on the quality of the water.

Mr. *J. W. Restler*, M. Inst. C. E., Engineer of the Company, was next examined by Mr. ALLCROFT. He said he could substantiate all that had been said by Sir Henry Knight. The 42-inch main to connect the source of supply with the Nunhead reservoir was completed, with the exception of one or two difficult points; and he anticipated that this would be sufficient for 20 years. The maximum capacity of the main was calculated on the growth of the district. In 1883 the Company were delivering 20 million gallons of water daily. In 1890 it had risen to 24 million gallons; but this would vary with the season of the year and the state of the weather at the time. The number of houses under constant supply on the 1st of January of the present year was 85,488, or equal to 75·76 per cent. of the total number of houses supplied by the Company. The filters were situated at Battersea and Hampton; the 11¼ acres at Battersea having to deal with 15 million gallons, and the 3¼ acres at Hampton with 12 million gallons per 24 hours. They intended to construct five additional acres of filters at Hampton, for which they purposed allocating £33,000; and with this it was proposed to proceed at once. The importance of the additional reservoirs at Nunhead was that this district was situated at such a level that the whole of it was supplied by gravitation from that point with the exception of a few high levels, which would be served from Forest Hill. The reservoirs at Nunhead would therefore ensure to the higher districts the continuity and efficiency of the supply at all times, irrespective of accident either to the mains or to the pumping machinery. With respect to the additional engine power, at the present time they had no reserve at all in connection with the supply from Hampton to Battersea; and if any breakdown happened, the supply to the district, to the extent of 15 million gallons a day, must be interrupted or suspended while the repairs were in progress. At Streatham, an experimental filter had been put up; and the result of the experiments was perfectly satisfactory. With regard to the complaints that had been made, the connection from the Company's main to the tank at the St. Olave's Workhouse Infirmary was very circuitous and had been altered, twisted, and changed from time to time—the tank being 86 feet above the level of the pavement. The Company had recommended alterations; but the Guardians had not carried them out. The Company had laid a new 12-inch main from the Old Kent Road round Deptford Lower Road and Dockhead, with the object of improving the supply to the workhouse and to one or two high model dwellings in the neighbourhood. The only complaint of any kind ever received from the Wimbledon Local Board was from Dr. Irvine Page, who happened to have a supply to a bath and a water closet taken directly off the main. This was not served from a cistern, but from the main; and immediately opposite where the connection was taken off, there was a supply to a street water-post. At certain hours of the day, when the water-carts were in use, temporarily, for a few minutes at a time, the water would not reach to Dr. Page's particular cistern or bath; but this would be entirely remedied when the high-pressure system was introduced.

Cross-examined by Mr. FREEMAN: With reference to the works under the Act of 1886, the expenditure on the Wandsworth works had been £44,000 for engines, buildings, and land; £4000 for mains; £5300 for engines and boilers in connection with the natural filtration system; £8000 for the completion of filtration works; £50,000 for the completion of the 42-inch main; and £25,000 for new offices. For the Streatham works £12,000 had been spent in sinking to the lower greensand; £47,000 on district mains; and £14,000 was the amount of the general capital expenditure at the works, extra boiler power, additions to the works, different connections, and so on. About £100,000 had been spent in excess of the powers given under the 1886 Act; being previous capital that the Company had in hand. All their capital powers had been exhausted; and he believed they would not have money enough even to pay for extensions now in hand.

Mr. FREEMAN: I suggest to you that if the Water Companies were all placed in the hands of one body, some of the arrangements which have to be made to enable each single Company, on their own ground and in their own district, to give a satisfactory supply, might be unnecessary, because it would be combined with other Companies.

*Witness:* I am perfectly certain that none of the works proposed under this Bill would be unnecessary.

Mr. FREEMAN: Would you have any objection to a responsible official of the Local Government Board seeing what your plans are, and satisfying himself that they are reasonable in view of the future purchase?

Mr. BIDDER: I will answer that question for the Company. We should greatly object.

*Witness:* Personally, I should object. I think it would remove the responsibility which at present rests, and rightly rests, on me as the technical officer of the Company.

Cross-examination continued: As to the filter-beds, he anticipated it would take two years to complete them; and he expected they would be commenced within a month, or less, of the Bill passing. The present filter-beds, judged by the standard of purity given by the analyst, were working satisfactorily; but they were only sufficient as long as they were all clean and in good order. As Major-General Scott had shown, at stated intervals it was necessary to stop them for cleaning out the whole of the sand; and on these occasions the other beds must be overworked. At times two of the three Hampton filters were out of use. He could not agree that they could clean them in a much shorter time than they now took, if they put on extra men. They never had a stronger inducement to clean them quickly than they had of late, because they were so urgently wanted. They could so ill spare them that they strained every nerve to shorten the time as much as possible; and even then it was more than six weeks before they could get them to work again.

Mr. ALLCROFT said, after what had been stated by the Committee, he did not propose to call Dr. Tidy to speak as to the purity of the water, except with regard to the Streatham well.

The CHAIRMAN said the Committee did not require any evidence as to the purity generally of the water supplied by the Company.

In reply to the CHAIRMAN, witness stated that the results of the experiments did not quite bear out General Scott's assumption as to possible danger from the pumping out of the sand at the Streatham well. If there was any real danger, they would prevent the sand rising pretty much in the same way as they prevented it getting into the collecting-pipes of the filters now, only by the converse arrangement—filling a certain portion of the deep well with very fine bagging, which would enable the water to pass over a sufficient obstruction to prevent the grains of sand rising. With the completed works, he was sure there would not be any danger.

This concluded the case on behalf of the promoters. The report of the remainder of the proceedings will be given next week.

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**Continental Union Gas Company.**—An extraordinary general meeting of the shareholders of this Company has been convened for the 2nd prox., at which the following resolution will be proposed: "That the 40,000 ordinary shares in the capital of the Company, which have been issued and fully paid up, be converted into stock, and be called ordinary stock, and that the whole of the preference shares in the capital of the Company be converted into stock, and be called preference stock."

**Todmorden Gas Company.**—According to the twenty-first annual report of this Company, the profits for the year ending March 31 last, amounted to £3231. From this sum the Directors recommend that the following dividends, less income-tax, be paid: On the consolidated stock, 10 per cent.; also 2½ per cent. for dividends in arrear, and 7 per cent. on the £5 paid-up share capital. The Directors also propose making a further reduction of 2d. per 1000 cubic feet in the price of gas, from July 1 next. This makes a total reduction of 1s. 6d. per 1000 cubic feet since 1883.

# MISCELLANEOUS NEWS.

## BIRMINGHAM CORPORATION GAS AND WATER DEPARTMENTS.

### The Committees' Annual Reports.

The annual reports of the Gas and Water Committees of the Birmingham City Council for the year ending March 31 last and the three months ended March 31, 1890, were issued last week.

The Gas Committee report that the manufacturing resources of the department were but barely sufficient to meet the large additional output of gas which was called for during the recent severe winter. They have had under consideration the extensions that will be required to meet the anticipated further increase in the output during the next four years, and have authorized an expenditure of £14,470 in the provision of purifying and other plant at the Saltley works, so as to render available the surplus retort power there of about 1,500,000 cubic feet per diem. The provision of this additional plant has been several times under the consideration of the Committee in recent years, but has been postponed from time to time pending the development of the Windsor Street works. It was hoped that the additions to these works would meet the increased output to the end of 1890. But accidental circumstances led to a large proportion of the increased output having to be provided at the Saltley works, both in the winters of 1889 and 1890; and having regard to these circumstances, the Committee have thought it essential that there shall be no further delay in fully equipping the Saltley works to their productive capacity of 10,250,000 cubic feet per diem. The Committee have authorized an expenditure of £38,337 for the completion of the equipment of the new retort-house at Windsor Street during the next two years, and in the provision of the additional purifying and other plant which will be required to increase the manufacturing capacity of the works from 7,200,000 to 10,550,000 cubic feet per diem before the winter of 1892. A portion of this increase will be available for next winter's supply. The Committee have included in this amount a sum of £4387, to be expended on a further trial of inclined retorts; the settings already constructed there on this system justifying, in the opinion of the Engineer, this further expenditure. In connection with these extensions of plant, the Committee have also had under consideration the desirableness of making additional provision for purification, or of alterations in the method of purification, for the further reduction of the sulphur compounds in the gas issued. They have ascertained that the working of the Claus system at Belfast on a large scale has not been sufficiently conclusive to justify them in depending exclusively upon this system at present for the purification of the large output from their works. Since the date of the experiments at Windsor Street, two new processes of purification—by lime only, or by lime and oxide of iron—have been introduced, one by admitting about 1 per cent. of air, and the other by admitting a somewhat less quantity of oxygen to the purifiers in operation. Both of these appear to have removed some of the objections which have hitherto attended the use of the lime process, and both have been successful in reducing the sulphur compounds to the requirements of modern legislation. The comparative cost of these two processes depends on the solution of the question whether any effect is produced by either on the illuminating power of the gas—a question which the Committee do not regard as definitely determined. It is claimed for the oxygen process that an increase in the illuminating power follows its adoption; while for the air process it is claimed that there will be no increase in the cost of maintaining the illuminating power of the gas to its present standard by its adoption. Apart from this question, the air and lime process is undoubtedly the less costly of the two; and in order that its actual cost, having regard to all circumstances, may be definitely ascertained, the Committee have authorized an expenditure of £4880 in the alterations of the plant required to carry it into effect at the Windsor Street and Saltley works. They have arranged that it shall be put into operation at these works during the coming autumn—this being the earliest date at which the change can be made; and that it shall be continued during the coming winter. The experience which they thus hope to obtain will enable them to determine whether any further provision will be required in the direction of additional purification. The Committee regret to report that, owing to ill-health, Mr. D. P. Mudie, the Superintendent of the Swan Village works, has recently been unable to give that close attention to his duties which is required. He has informed the Committee that his medical adviser is of opinion that, while leave of absence would enable him to return to the greater portion of his duties, it is not probable that he will again be able to exercise any close supervision of the work in the retort-house. Mr. Mudie is not a member of the superannuation fund which was formed by the Gas Committee in 1876, as he was then beyond the age at which contributions were accepted from the staff without back payments. The Committee have informed him that they think it desirable to make early provision for the effective supervision of the works; and he has offered to place his resignation in their hands. They recommend that his resignation be accepted, and that, in recognition of his long and useful service, he be paid a retiring allowance of £100 per annum for the rest of his life. His salary is £350 per annum; and he is provided with house, coal, gas, and water free. The Committee report that they have received the resignation of Mr. S. Meunier, the late Superintendent of the Adderley Street works, who has been promoted to an appointment at Stockport. They have appointed Mr. R. V. Milne, draughtsman at the Windsor Street works, to succeed him, and have made other necessary changes in the staff following on this appointment. In connection with the expenditure already authorized in the current year in additions to, and enlargement of, trunk mains, the Committee have sanctioned an expenditure of £1050 in enlargement of the trunk mains supplying the district of Pershore Road and neighbourhood. At the request of the Public Works Committee, the Committee have agreed to supply lanterns and fittings for courts at cost price. Repairs of meters for the half year ended March cost £2870 12s. 2d. The number repaired was 4109. The statistics for the half year ended March 31, 1891, as compared with the corresponding period of the previous year, show that the sale of gas in the period in question amounted to 2,574,185,000 cubic feet, as compared with 2,469,194,200 in the corresponding period. The new services laid were 1221, as compared with 1365.

The Committee submit the balance-sheet and statement of accounts for the quarter ended March 31, 1890, and for the year ended March 31, 1891. The net profit for the quarter ended March 31, 1890, amounted to £38,471 after an appropriation of £1074 to the sinking fund for the redemption of loans and annuities. The net profit for the year ended March 31, 1891, amounted to £36,785, after appropriating £4216 to the sinking fund. The Committee recommend that £30,000 shall be appropriated to the improvement rate of 1890, and that the sum of £45,256, being the amount of the net profit for the quarter ended March 31, 1890, and the balance of the profit for the year ended March 31, 1891, be added to the sinking fund. The Committee have informed the Finance Committee that they hope to be able to pay to the improvement rate a sum of £25,000 from the profits of the undertaking in the year ending March 31, 1892.

The following are the principal items (shillings and pence omitted) of the revenue account, preceded by those for the previous year:—

*Expenditure.*

| 1889. | | 1890–91. | |
|---|---|---|---|
| £181,918 | Coals | £250,594 | |
| 3,523 | Purifying materials and wages | 3,582 | |
| 4,467 | Salaries at works | 4,790 | |
| 40,985 | Wages at works | 52,725 | |
| 68,761 | Repairs and maintenance | 75,092 | |
| | | | £386,785 |
| | Distribution of gas— | | |
| 12,217 | Salaries in light office | £12,238 | |
| 10,683 | Repairs, maintenance, and renewal of mains and service-pipes | 16,353 | |
| 5,743 | Repairing, renewing, and refixing meters | 6,196 | |
| | | | £34,788 |
| 2,533 | Lighting and repairing public lamps | | 2,561 |
| 18,423 | Rent, rates, and taxes | | 17,952 |
| 8,550 | Management | | 8,188 |
| 5,249 | Law charges, bad debts, and expenses of loans and annuities | | 1,509 |
| £363,088 | Total expenditure | | £451,786 |
| 165,124 | Balance carried to profit and loss account | | 131,246 |
| £528,212 | | | £583,032 |

*Receipts.*

| | | |
|---|---|---|
| £401,695 | Sale of gas | £423,058 |
| 122,041 | Residual products | 154,913 |
| 2,582 | Rents | 1,953 |
| 1,149 | Fittings | 2,180 |
| 741 | Discounts and transfer fees | 925 |
| £528,212 | | £583,032 |

Included in the total receipts from the sale of gas are the following items: Common gas, 1,240,365,900 cubic feet, at 2s. 7d. per 1000 cubic feet, £160,213; ditto, 514,354,500 feet, at 2s. 5d., £62,151; ditto, 1,858,026,200 feet, at 2s. 3d., £209,027; and public lighting and under contracts, £11,100.

The report of the Water Committee states that it is hoped the works at the Longbridge Well (Northfield) will be completed so as to render water available for supply by August next. The protracted frost of last winter severely taxed the resources of the department. At one time water froze in pipes at a depth of 2 ft. 6 in. below the surface of the ground, thereby entirely stopping the usual supply to large numbers of consumers; while, from taps being kept constantly running, and from burst pipes, an enormous waste of water was taking place. The consumption reached as high as 147 million gallons a week, being an increase of 27 millions upon the highest consumption previously known. A very heavy additional cost was occasioned by the extra pumping which was required in consequence of the frost, by the repairs to mains and works which suffered injury from the same cause, and by the special means taken to facilitate distribution. The total number of water-fittings examined by the department during 1890 was 37,007, of which 33,159 were passed and stamped, and 3848 were rejected. With regard to plumbing work in water-fittings, it is remarked that, acting on reports from Mr. Gray, the Engineer (who is satisfied with the great advance in the quality of plumbing, and with the operation of the existing bye-laws for examining and stamping plumbing work), the Committee recommend that henceforward the Water Department shall restrict itself to laying services up to houses, &c., leaving internal fittings to the authorized plumbers. Dealing with the accounts, the report states that the item of "working engines and wages" has risen from £16,891 in 1889 to £23,351 for the year ended March last; and of this increase £3732 is attributed to the enhanced cost of coal. On the other hand, the receipts from water-rentals show an increase of £6281 and the profit for the fifteen months amounts to £2845. Deducting this from the amount of the deficiency on Dec. 31, 1889 (£17,144) the present deficiency on the department is £14,299. Since the Corporation took over the water supply in 1876, the capital expended in extensions, &c., has amounted to £516,068. New mains to the extent of 231¾ miles have been laid during that period, at a cost of £211,763; and the daily supply has risen from 8·3 million gallons in 1876 to 16·82 million gallons in the year just closed. The present storeage capacity is 645 million gallons; whereas when the Corporation took the supply over, it was only about 200 million gallons. The revenue from water-rentals has risen from £93,527 in 1876 to £139,964 in the past year; and the working expenses have increased from £38,318 to £82,189. During the fifteen years 73,492 additional houses have been added to the supply, for which 37,511 of these houses pay 10s. or less annually; and there are now 5685 fire hydrants on the water-mains. The balance-sheet for the year ending March 31 last shows a revenue from water-rents of £135,134, against £128,851 in 1889; and a total revenue, including the sale of fittings, rents of land and cottages, fishing rights receipts, and transfer fees, of £136,964, against £130,661. The expenditure in wages was £2656, against £2508; salaries, £7825, against £7870; working engines and wages, £23,351, against £16,891; rent, tithes, rates, and taxes, £7683, against £7699; office expenses, £2033; the total expenditure for the twelve months being £52,943, against £45,423. The gross balance of revenue over expenditure on supply was therefore £84,020, as compared with £85,238. Of this balance, annuities

absorbed £53,838 19s., against £53,839; interest on loans, £1448, against £1115; interest on Corporation stock, £21,868, against £21,935; interest on reserve fund, £2000, against a like amount; sinking fund, £3875, against £3337; and after meeting other small items of expenditure, the net surplus for the past year was £936, against £2878 for 1889. For the extra three months included in the accounts, the revenue was £32,933, and the expenditure on supply £11,243; leaving a gross balance of £21,689. Of this, annuities absorbed £13,459; interest on loans, £316; interest on Corporation stock, £5370; interest on reserve fund, £500; and interest on bank accounts, £134—the net profit of the undertaking being £1909. The capital and loan accounts of the department now stand at a little over two millions sterling.

## STAFFORD CORPORATION GAS SUPPLY.

### The Past Year's Working—Fortnightly Payments for Gas.

At the recent Quarterly Meeting of the Stafford Town Council, the Gas Committee presented their report on the working of the Gas Department in the year ending March 25 last. It was accompanied by an analysis of the accounts of the department for this period, prepared by the Manager (Mr. J. Ferguson Bell, Assoc. M. Inst. C.E.).

The Committee commenced by expressing their pleasure that the report they submitted was far more satisfactory than had been anticipated. Although coal had maintained its high price, and wages had been considerably higher than in previous years, the profits, notwithstanding the reduction in the price of gas, had amounted to rather more than were reported as the result of the previous year's working. The sale of gas had very greatly increased; the total quantity made being 102,875,000 cubic feet—a rise of 8,965,000 cubic feet, or 9·55 per cent. This was the largest make ever recorded; and was doubtless owing to the lower price of gas, the past severe winter, the number of artizans who had availed themselves of the fortnightly payment system, and the number of gas-engines and gas-fires in general use. In fact, the demand for gas had been so great, that the works were scarcely able, at certain periods, to supply all that was needed, and in their present condition would be unable to supply the anticipated demand for next winter. Hence the application for a loan of £15,000, sanctioned by the Council in March last, for the purpose of adding to the producing power, increasing the storeage capacity, constructing railway sidings, purifiers, coal-shed, &c. These extensions are now in progress; and when they are finished the works will, it is believed, be as complete as any in the kingdom. The coal carbonized in the past financial year was 11,284 tons, costing £5519 13s. 11d.; and the sum obtained for residuals amounted to £4210 16s. 6d.—an increase of £650, or nearly 76 per cent. on the total cost of the coal. The Committee called special attention to this highly gratifying fact, which, they said, reflected great credit on their excellent Manager. The total receipts for the year were £17,952 11s. 9d.; the expenses, £11,112 3s. 9d. The gross profit was £6840 8s., or £11 8s. more than last year; so that the fears entertained by the Committee as to a possible temporary falling off in revenue were not realized. Out of this sum there was paid £2885 16s. 8d. for interest, £1513 14s. 9d. for repayment of loans, and £171 9s. 8d. for income-tax; thus leaving a net profit of £2269 6s. 11d., which, added to the sum of £251 3s. brought forward, made the amount at the disposal of the Council £2520. The Committee recommend that £2000 of this should be paid to the district fund (out of which £329 8s. 1d., standing to the debit of the Electric Lighting Committee, should be paid off); £500 transferred to the reserve fund; and the rest carried forward. This would make a total of £19,600 paid in relief of the rates by the Gas Department. The loans repaid amount to £15,027 18s. 8d.; while a sum of no less than £11,026 14s. 1d. has been spent to extend and improve the works and maintain them in their present high state of efficiency. Gas-fittings were supplied to 700 fortnightly consumers, at a total cost of £1445 9s. 10d., which has been defrayed out of the reserve fund. The gas sold on this system amounted to £529 10s. 1d. for the year; and the Committee stated that as the artizan classes appreciate this arrangement made on their behalf, the number of consumers may soon be considerably increased. They regarded the prospects of the current year as very satisfactory; and they hoped that the extensions and improvements of the works now undertaken would make them sufficient to meet all requirements, and obviate further expenditure on capital account for many years to come.

From an analysis of the accounts prepared by Mr. Bell, we find that the capital of the undertaking at the close of the year amounted to £72,555, or at the rate of £6 8s. 7d. per ton of coal carbonized, and 15s. 4d. per 1000 cubic feet of gas sold. The quantity of gas made per ton of coal was 9117 cubic feet, of which 8377 cubic feet were sold; being 91·92 per cent. of the make. Proceeding further on this basis, we find the net cost of the coal was 2s. 5·72d. per ton; manufacturing expenses being 4s. 10·29d.; and distribution expenses, 1s. 5·67d.—management and other matters bringing up the total expenditure to 12s. 2·79d. per ton of coal. As the sale of gas and the rental of meters work out to 24s. 3·78d. per ton, there is shown a gross profit of 12s. 1·49d.; the net profit being 4s. 0·27d. Deducting the amount paid into the reserve fund, and adding last year's balance, there is left a sum of £2020 9s. 11d., which is at the rate of 3s. 6·97d. per ton of coal.

Alderman PEACH, in moving the adoption of the report, said the gas sold by meter in the past year amounted to 87,382,850 cubic feet; that used in the public lamps to 6,707,000 cubic feet. The gas unaccounted for was about 7 per cent. on the total make, or ½ per cent. more than last year; the increase being due to the waste incurred in making so many connections. For the sale of gas, £12,156 13s. 10d. was received; and for public lighting, £1188 17s. 6d.—making a total of £13,345, or an increase over last year of £595 5s. 3d. The receipts for residuals were £66. Coke showed an increase of £528; tar, of £216; but there was a decrease of £79 on sulphate—prices having declined about £1 per ton. As the residuals brought back 76 per cent. of the price of the coal, this had cost only 2s. 6d. instead of 10s. a ton. Coal had cost £868 more in the year; wages, £200 more; and the reduction in the price of gas came to £573. The amount of profit (£6840) was 40 per cent. on the turnover; but the payment of interest and the repayment of loans cut it down very seriously. Regarding the fortnightly consumers, the total applications received had been about 800. Of these 700 had been supplied; others would be connected as soon as possible; and some had withdrawn their orders until the winter. The cost of fitting up was about £2 per house; and upwards of 3 million cubic feet of gas had been used by these consumers. After allowing for the expenses of collection, and interest and depreciation on the cost of fitting up the houses, the Committee found that the consumers on this system, although nominally paying more than the quarterly consumers, really paid a fraction less, which was practically the same. Last year the Committee were afraid that the reduction in the price of gas would cause them to make £750 less profit than in the previous year. They carried £250 forward from last year's account; and they anticipated that by this sum, and by paying nothing into the reserve this year, they would be able to meet the decrease. They were agreeably surprised, however; for the actual reduction in income from gas sold, owing to the lower prices, was only £573, and residuals showed a large increase. Consequently, they could not only carry £500 to the reserve fund, which was their working capital, but hand over £2000 to the relief of the rates, and carry forward a very small balance. The prospects for the current year were satisfactory; and the Committee did not anticipate any reason to regret having given so large an amount.

The report was adopted.

## THE LANCASHIRE GAS COAL TRADE.

### From Our Own Correspondent.

Just for the present, business throughout the coal trade of Lancashire is almost entirely in suspense, owing to the usual Whitsuntide holiday stoppages of the pits. In the immediate neighbourhood of Manchester, these cessations of work extend over fully a week; and in other districts in most cases for three or four days. There is consequently very little to report so far as actual trade is concerned. The stoppages of the pits (which in many cases, owing to the action of the men themselves, run over a longer period than usual) must, however, tend to give a steadiness to the market where prices were showing a tendency to decline. In addition to this, there is the fact that, notwithstanding the advanced period of the year, comparatively little or nothing has so far been put down into stock at any of the Lancashire collieries; and although it is only natural to expect a considerably lessened demand during the ensuing summer months, any surplus supplies will be largely required to lay down into stocks to meet forthcoming winter requirements. The exceptional condition of things points to the possibility of prices being steadily maintained at something like current rates; and certainly there would seem to be little probability of any very material giving way, as the miners themselves will endeavour to counteract any weakening of the market by a still further restriction of the output. There is nothing new, so far, to report with regard to gas coal contracts, except that the forms of tenders of the Salford Corporation have been sent out during the past week, and colliery proprietors are being asked to quote not only for this year's supplies, but for deliveries over the next two or three years. Quoted prices remain nominally the same as those given last week. Best Wigan Arley at the pit's mouth, averages 12s. to 12s. 6d. per ton; second qualities of Arley, 10s. 6d. to 11s.; Pemberton 4-feet coals, 10s. to 10s. 6d.; common house-fire coals, 9s. to 9s. 6d.; steam and forge coals, 7s. 9d. to 8s. 6d.; burgy, 7s. to 7s. 6d.; good qualities of slack, 6s. to 6s. 6d.; and common, 4s. to 4s. 6d. Steam coal is still offered for shipment at low figures; and, delivered at the High Level, Liverpool, or Garston Docks, it can be bought at 9s. 6d. to 10s. per ton.

**Young's Paraffin Light and Mineral Oil Company, Limited,** intimate that their books for the financial year ending April 30, 1891, after expending £25,902 for the maintenance and repairs of works, pits, and mines, and subject to audit, show a profit on the year's operations of £74,715. Adding the balance from last year, £3836, makes a total of £78,551. From this sum interest on the mortgage debenture bonds and on the 6 per cent. convertible debenture stock has to be deducted; leaving £54,131, out of which the Directors recommend a dividend of 9 per cent. less income-tax. These payments will absorb £23,993, and leave a balance of £30,138. From this it is recommended that the sum of £25,000 be written off against the Pentland retorts and royalty account, which will leave £5138 to be carried forward.

**The Payment of Rates upon the Full Value of Gas-Mains.**—At the Tamworth Police Court last Wednesday, the Gas Company and their Manager (Mr. E. Sapey) were summoned for the non-payment of £4 1s. 8d., the amount of the general district rate. The summons arose out of a recent resolution of the Town Council to call upon the Company to pay rates upon the full value of their mains. Mr. Shaw, for the Company, raised an objection to the sitting Magistrates, stating that with one exception they were members of the Corporation, and were therefore really the prosecutors; and he suggested that Mr. Wales and Mr. M. Sadler, of the Borough Bench, should sit with two Magistrates of the County Bench to adjudicate upon the summons. To this course no objection was taken; and it was ultimately agreed that the case should be dealt with in that way at an early date.

**Portsmouth Water-Works Company.**—The report of the Directors of this Company for the past six months states that no less than 1386 yards of additional street service mains have been laid in new roads and streets; making a total of more than 92 miles of service mains and 45 miles of trunk mains in the Company's district, the whole of which are under constant pressure. During the same period there have been 254 additional premises connected with the mains; making the total number 33,953. The average quantity of water supplied for all purposes has been 5,288,000 gallons per day—an increase of 442,000 gallons, as compared with the corresponding period of last year. Turning to the accounts, it is seen that the available balance on the profit and loss account is £14,611, out of which the Directors recommend the payment of statutory dividends, which, after the usual deductions, will leave a balance of £780 to be carried forward.

## GEORGETOWN (BRITISH GUIANA) GAS COMPANY, LIMITED.

The Half-Yearly General Meeting of this Company was held last Tuesday, at the London Offices, No. 30, Gracechurch Street, E.C.—Mr. ALFRED WILLIAMS in the chair.

The SECRETARY (Mr. Alfred Lass, F.C.A.) having read the notice of meeting, the Directors' report, and the statement of accounts for the half year ended Dec. 31 last were taken as read (see *ante*, p. 842).

The CHAIRMAN, in moving the adoption of the report, said he would simply make one or two observations in reference to the balance-sheet which they had before them. He thought the shareholders would regard the accounts as extremely satisfactory, inasmuch as the expenses of the half year were less than those of the corresponding period of last year, and the receipts were very nearly £200 in excess. They would thus be enabled to maintain their dividend and to place £500 to the reserve fund.

Mr. CHARLES NEWTON seconded the motion, which was carried unanimously.

On the proposition of the CHAIRMAN, dividends were then declared for the half year ended Dec. 31 last at the rate of 8 per cent. per annum on the preference share capital, and at the rate of 7 per cent. per annum on the ordinary share capital, both less income-tax (except as regarded shareholders resident at Georgetown); payable on June 1.

Captain THURBURN then moved that Mr. Alfred Williams be re-elected a Director of the Company, and said that as Chairman he had done excellent service for a great many years.

The motion having been seconded and carried, the CHAIRMAN briefly thanked the shareholders, and proposed the re-election of Mr. Charles Newton as a Director.

Mr. MAGNUS OHREN seconded the motion; and it was carried unanimously.

The CHAIRMAN referred to the great loss the Company had sustained by the death of Mr. Robert King, who had joined the Company at the very outset—he believed, in 1871; and said it now devolved upon them to elect a successor as Auditor. The Directors had already communicated to the family their regret at Mr. King's death.

Captain THURBURN then proposed, and Mr. NEWTON seconded, that Mr. Magnus Ohren be appointed one of the Auditors of the Company.

The proposition having been agreed to, Mr. MAGNUS OHREN briefly returned thanks for his election.

The CHAIRMAN moved a vote of thanks to the Secretary (Mr. Lass), the Local Secretary (Mr. F. A. Conyers), the Engineer (Mr. T. B. Younger), the Auditor (Mr. R. Berridge), and the Solicitor (Mr. E. K. Blyth), for the services they had rendered to the Company during the past half year.

Mr. C. GANDON seconded the motion, which was carried.

Mr. LASS, on behalf of the officers of the Company, acknowledged the compliment.

On the motion of Mr. OHREN, a vote of thanks was passed to the Chairman and Directors for their services.

The CHAIRMAN responded; and the proceedings terminated.

## SINGAPORE GAS COMPANY, LIMITED.

The Adjourned Annual Ordinary General Meeting of this Company was held last Thursday, at the Cannon Street Hotel, E.C.—Mr. R. S. FOREMAN in the chair.

The SECRETARY *pro tem.* (Mr. R. M. Christie) read the notice convening the meeting; and the report of the Directors and the statement of accounts for the half year ending Dec. 31 last were taken as read. The former showed that, after charging the profit and loss account with the usual writings off, and placing £150 from the reserve fund to the credit thereof, there remained a balance available for dividend of £1852 18s. 5d.

The CHAIRMAN said that, in accordance with the Articles of Association, the annual general meeting was held *pro formâ*, at the Company's Offices, on the 30th ult., and the meeting was then adjourned to that day, in consequence of the recent death of Mr. Robert King who had acted as Secretary to the Company since its establishment in 1862. The estimation in which Mr. King was held by the Directors, and their regret at the loss of his valuable services, would, he was sure, be endorsed by all the shareholders, to whom he was so well known. Early in the half year, the Directors also lost the able assistance of their esteemed colleague Mr. Robert Rice, whose death was followed shortly afterwards by that of his brother-in-law (Mr. Garraway), one of the oldest shareholders, and a constant attendant at their meetings. Still more recently, they were much concerned on hearing of the death of Mr. Stephenson Clarke, of the well-known firm of that name. Mr. Clarke was one of the first Directors of the Company; and although he retired from that position many years ago, he still retained a considerable holding in the concern. With this passing tribute to the memory of old and valued friends, the Chairman proceeded to the business of the meeting. He said that mention was made, at the last meeting of shareholders, of the inactive state of trade which had so long existed at Singapore, and of the great depreciation in the value of real estate which had taken place there and throughout the Straits Settlement. At the close of the year there was no improvement in this respect, although the Directors had been since informed that business was now somewhat better; and they trusted that, as the year advanced, this improvement would be maintained. This inactive condition of trade had certainly materially affected the gas-rental, which showed a further reduction for the half year. The sales of coke and the profit on fittings also exhibited a corresponding reduction. It had often been remarked that, in times of trade depression, the Chinese used gas very sparingly, and that, as trade improved, it was much more freely burned in their private dwellings and business houses, and also in the illuminations which took place at their periodical festivities. For the last twelve months the public lighting department had been very active; and a considerable number of additional lamps had been erected. This would be considered very satisfactory were it not that it required an extension of mains to the outlying districts, which at present yielded a poor return beyond that derived from the public lighting. From a statement prepared by Mr. King some time previous to his death, he (the Chairman) found that, from Dec. 31, 1883, to June 30, 1890, the large sum of £21,400 had been expended at Singapore upon works and plant and new mains, services, &c.; and that, during the same period, the increase in share capital and debentures only amounted to £9155. The difference between these two sums had had to be provided for out of revenue. The Company were now, therefore, in want of increased working capital, and the Directors had in consequence decided to issue a further limited amount of new shares. A circular to this effect would be shortly forwarded to the shareholders. Before concluding he mentioned that arrangements had been lately made by which a considerable saving would be effected in the working expenses of the Company, without in any way deteriorating from the efficient working at Singapore. The shareholders would see by the report that Mr. S. Spencer had been elected a Director in place of the late Mr. Rice. He was a gentleman well known to most of the shareholders; and the Directors believed that from his long acquaintance with all matters relating to the manufacture of gas, he would be a valuable acquisition to the Board. Mr. Christie, who had for some years assisted Mr. King, had been appointed Secretary *pro tem*; and the Directors thought, from the manner in which he had performed the duties devolving upon him, that the appointment would shortly be made permanent. The Chairman concluded by moving that the Directors' report and the accounts be adopted.

Mr. H. W. SMITH, in seconding the motion, said he had two or three remarks to make with regard to the issue of new shares. For the past twelve or eighteen months, they had felt the want of working capital for general purposes. They had been trying an experiment in letting fittings out on hire; and their Engineer (Mr. W. T. Batten) had made a report in which he spoke very encouragingly of it, and advised the Directors to extend this branch of business as early as possible. They had not, however, yet extended it, simply because they had not the means of doing so; but if they had more working capital, this new source of profit could be developed. He also mentioned that several debenture bonds would fall due shortly; and it was the intention of the Directors to pay them off. They paid 6 per cent. on the bonds; and this might just as well be given to the shareholders.

The motion was unanimously carried.

On the proposition of the CHAIRMAN, seconded by Mr. F. A. M. NICOL, a dividend at the rate of 6 per cent. per annum, less income-tax, was declared.

Mr. R. GARRAWAY RICE moved, and Mr. ROBBINS seconded, the re-election of the retiring Director (Mr. Nicol).

The motion having been agreed to,

The Auditors (Messrs. C. Newton and B. Green) were re-appointed on the motion of Mr. MAGNUS OHREN, seconded by Mr. FEATHERSTONE.

Mr. OHREN, in moving a vote of thanks to the Chairman and Directors, remarked that he could quite understand the difficulties under which they laboured for want of capital; and he was glad to find they were going to raise more, as he was quite certain that, with capital at their backs, they would get on a good deal better than they had done.

Mr. RICE seconded the motion, which was unanimously agreed to.

The CHAIRMAN having responded, the proceedings terminated.

## BAHIA GAS COMPANY, LIMITED.

The Half-Yearly General Meeting of this Company was held last Thursday, at the London Offices, 9, Queen Street Place, Cannon Street, E.C.—Mr. EDWARD HORNER in the chair.

The SECRETARY (Mr. T. Guyatt) read the notice convening the meeting; and the report of the Directors and the accounts for the half year ending Dec. 31 last were taken as read. The report stated that the profit was £6462, which, added to the amount brought forward, made the sum of £9143, out of which the Directors recommended the usual dividends on the preference shares, and a dividend at the rate of 8 per cent. per annum (free of income-tax) on the ordinary shares, which would absorb £6225; leaving a balance to be carried forward of £2918.

The CHAIRMAN, in moving the adoption of the report and accounts, said that the profit amounted to £6462, as against £6072 for the corresponding six months. But for the loss on exchange, and the increased sum written off for bad debts and allowances (together more by £1724 than in the half year ending December, 1889), the balance of profit would have been £8187. As it was, the Directors considered the profit was satisfactory. Notwithstanding the advance in the price of coal, the average cost at Bahia had been less; the Board having been fortunate in securing low freights. In this connection, another good feature was that, while the quantity of coal carbonized had been less by 462 tons, the returns in rental and for residuals showed an increase of £349. The make of gas per ton still continued very good—being more than 10,000 cubic feet; and the illuminating power had been maintained. Turning to the balance-sheet, it would be seen that £718 had been expended on capital account for an extension of public lamps. This outlay had already proved profitable; it produced an increased rental amounting to £213. Notwithstanding the efforts made by their Manager, the arrears were still excessive. The public lighting accounts were five months in arrear; and but for this the total would have been reduced within reasonable limits. The balance-sheet also showed that the stocks were large; and this was chiefly due to the item of coal. The reserve fund invested had been increased by the investment during the half year of the interest received. He might also mention that, if the Company had not lost such a large sum on exchange, the Directors would have paid the same dividend as formerly; but, of course, this was a matter which they could not control. As to the concession, the Provincial Government had recently made a preliminary move; but as yet the Directors had not received the conditions of tender. He could therefore only repeat that the shareholders might rest assured that the Directors would do everything in their power to protect the interests of the Company.

Mr. HORATIO BROTHERS seconded the motion.

Mr. J. E. JONES said that, since the last meeting, there had been a very considerable improvement in matters; and he thought it would not be right, remembering the remarks that fell from him six months ago, if he did not bear his testimony to the improvement in the management. During the six months, the quantity of coal carbonized had been much less, but nevertheless an increased amount of gas had been sold. The decrease in the coal used was no less than 7 per cent.; while they had obtained quite 10 per cent. more for the gas sold. Then in the purifying department, there had been a saving of no less than 12½ per cent., which was a clear proof that the management was looking into the little details, in which so much money might be spent unwisely. Salaries had decreased by £40; and rent and taxes by £140. There had been a small increase in mains and services and also in public lights; but this must give greater satisfaction. Having mentioned that bad debts was a heavy item, he said that nearly all South American gas companies had to complain somewhat of the large amount of arrears due from the Governments. Regarding the public lighting, he might say that, going back over the data at his command for the past eleven years, the sum received under this head in the past six months was really the largest of any half year during the period; and for products and fittings, the amount received was only £30 less than the heaviest sum they had realized in any of the half years. As to the private consumers, the increased quantity of gas used had only been from 1½ to 2 per cent. This was not so great as they would have liked; and he suggested whether the Directors could not stimulate consumption by a reduction in price, or by making an allowance for prompt payment.

Mr. H. FINLAY observed that there were only one or two blots in the balance-sheet. There was the loss on exchange of £1261; but the Directors had no possible control over that. The other "blot" was the amount they had had to write off for bad debs; but the Directors spared neither time nor trouble in bringing this matter under the notice of their Manager.

Mr. BROTHERS remarked, with regard to the price of gas, that whether they charged too much or too little, it would not be well to alter it at present, as the concession had only about a year to run. The question of price might therefore be left for the new concession.

The motion was carried unanimously.

The dividends recommended in the report were then declared, on the motion of the CHAIRMAN, seconded by Mr. BROTHERS.

A vote of thanks having been passed to the officers and staff,

Mr. MAGNUS OHREN moved a similar compliment to the Chairman and Directors; and, in doing so, he said that the shareholders congratulated them on the change they had made in the management at Bahia. There was no doubt that the accounts were now in a first-class condition, with the exception of one or two little points which had been mentioned. He agreed with what had been said as to the price of gas. If the charge could be reduced, there would be more likelihood of people burning gas; but making an allowance for prompt payment would be far better than reducing the price generally, as the latter course benefited the bad payers as well as the good ones.

Mr. WRIGHT seconded the motion, which was agreed to.

The CHAIRMAN having returned thanks for the Directors, and the SECRETARY for the officers and staff, the proceedings terminated.

## MONTE VIDEO GAS COMPANY, LIMITED.

The report of the Directors of the above-named Company for the year ending Dec. 31 last, with the accounts for this period, has been issued by the Secretary (Mr. A. G. Hounsham), in view of the general meeting of shareholders which is to be held on Friday next. The net profit on the working of the year, as shown by the revenue account, was £42,256 16s. 5d., which has been passed to the credit of profit and loss. From this latter account, provision has been made for interest on debentures and for income-tax, loss on exchange, and bad and doubtful debts; and £2454 8s. 4d. has been written off capital expenditure for depreciation. The balance then remaining at the credit of profit and loss, available for dividend, is £39,259 9s. 3d. Of this the Directors paid on Dec. 1, 1890, an interim dividend in respect of the half year ended the 30th of June, of 12s. per share, free of income-tax; and they now recommended the payment of a further amount of 14s. per share, also free of income-tax—making together a dividend of 6½ per cent. for the year. This will absorb the sum of £35,224 16s., and leave a balance of £4034 13s. 3d., to be carried forward. The reserve fund remains at £70,000; and the insurance fund at £11,500. Notwithstanding the commercial crisis in Monte Video in the summer of last year, the report states that the consumption of gas by private consumers continued to increase until nearly the close of the year, although not sufficiently to compensate for the reduction in the public lighting. The Company's contract with the Municipality of Monte Video expired in March, 1887, and is still unrenewed. But the services of the public lamps, even in the remotest parts of the city, have, at the instance of the lighting authorities, to be kept fully charged with gas, in order that the lighting may be taken up again by the Government should circumstances demand it. In the summer of 1890, the Board decided that it would be to the advantage of the Company that the duties of Manager and Engineer in Monte Video should be divided. The engagement of the Manager (Mr. John Ohren) was about to expire; and Mr. T. F. Lane, who had been in the service of the Company since its incorporation, and during the last six years as Secretary, was appointed General Manager. Mr. Robert Morton, one of the Directors, proceeded to Monte Video to inaugurate this change of management, and to make himself personally acquainted with the position of the Company's affairs there, and the working of the business generally. He saw Mr. Lane duly installed in his office, and appointed Mr. James Anderson as Resident Engineer; making also important changes in the staff. Mr. Morton made an exhaustive inspection of the Company's works, and, as far as possible, of the mains. He carefully revised the methods of working and distribution; very materially reducing the cost in both departments. He also made the necessary alterations and arrangements for carrying out the new works in course of construction; and he reports that these will shortly be in a position to supply the greatly increased demand for gas which he is confident will follow the expected revival of prosperity in Monte Video. Some signs of this revival are, it is stated, already beginning to appear. The Board feel that the practical information thus obtained by Mr. Morton will prove of great advantage in the future working of the Company. The new gasholder referred to in the last report was duly completed, and is working well.

## METROPOLIS WATER SUPPLY.

### The Quality of the Water in April.

The returns furnished to the Registrar-General by the London Water Companies as to the water supply of the Metropolis during the past month, show that the average daily supply was 174,273,526 gallons, as compared with 165,831,363 gallons in the corresponding month of 1890; being at the rate of 28·9 gallons per head of the population. Of the entire bulk of water sent out, 87,367,489 gallons were drawn from the Thames, and 86,906,037 gallons from the Lea and other sources. Reporting upon the quality of the supply, Dr. E. Frankland said: Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health was: Kent, 0·9; Tottenham, 1·2; East London (deep-well) and New River, 1·4; Colne Valley, 1·6; East London (river supply), 2·7; Southwark, 3·1; Grand Junction, 3·4; West Middlesex, 3·6; Chelsea and Lambeth, 3·7. The water abstracted from the Thames by the Chelsea, West Middlesex, Southwark, Grand Junction, and Lambeth Companies was, on the average, slightly inferior to the samples reported upon last month, but was of about its normal quality at this season of the year. It was efficiently filtered. The water taken chiefly from the River Lea by the New River Company ranked, in respect of organic purity, with the deep-well waters; and that delivered by the East London Company from the same source was superior, in this respect, to any of the Thames-derived waters. Both waters were efficiently filtered before delivery. The deep-well waters of the Kent, Colne Valley, and East London Companies, and of the Tottenham Local Board of Health, were all of excellent quality for dietetic use; and the Colne Valley Company's water, having been softened before delivery, was rendered suitable for washing. All these waters were clear and bright without filtration. Seen through a stratum 2 feet deep, the New River, Kent, Colne Valley, Tottenham, and East London (deep-well supply) waters were clear and colourless; while the remaining waters were clear and very pale yellow. The bacteriological examination by Dr. Koch's process of gelatine plate culture gave the following results: One cubic centimetre of each water collected in sterilized vacuous tubes, on the same days as the samples for chemical analysis, developed the following numbers of colonies of microbes: Southwark, 26; West Middlesex, 50; New River, 70; Chelsea, 90; Grand Junction, 102; East London, (river supply), 122; Kent, 134; and Lambeth, 1126.

Messrs. Crookes, Odling, and Tidy, in their report for the past month on the composition and quality of samples of the water supplied to London, say: "Of the 182 samples examined, the whole were found to be clear, bright, and well filtered. Throughout the month of April the condition of the water supply to the Metropolis continued to be entirely satisfactory, in respect alike to freedom from turbidity, from colour-tint, and from excess of organic matter. Thus, in the case of the Thames-derived supply, the mean ratio of brown to blue tint was as 13·9 : 20; the mean amount of oxygen required for oxidation, 0·055 grain per gallon; the mean amount of organic carbon, 0·155 part in 100,000 parts; and the maximum amount in any single sample examined, 0·190 part in 100,000 parts of the water—numbers which correspond very closely with those recorded as expressing the results furnished by the previous month's supply."

**Messrs. J. and W. Wood,** of London and Glasgow, have just added to their other colliery properties the Bryndu Cefn Collieries in South Wales.

**The Public Lighting of Barnet.**—At the meeting of the Barnet Local Board on the 5th inst., a discussion took place on the subject of the future lighting of the town. The Lighting Committee reported that no tenders had been received for electric lighting; and they recommended that offers be invited from persons willing to carry out any system—electricity, gas, oil, or even candles. Mr. Parsloe said he could not quite endorse the Committee's recommendation. It was true that tenders for electric lighting had been asked for, and none had been forthcoming. He did not think the proposal was a serious one, to light the town with oil; and the only resource, therefore, upon which they could fall back, was the Gas Company. But if the Board went back to them, they would, of course, be inclined to charge their own price. As far as electric lighting was concerned, he was afraid the Board would fail, unless they decided to do the work themselves; and this they were disinclined to do. As gas was the only resource, was it not desirable to test the feeling of the Company by deputation or otherwise? The Company would not tender for the lighting of the town; and if the Board wanted to make terms, now was the time to do it. Mr. James said it was not quite correct that the Board were at the mercy of the Gas Company. They could compel the Company to light the town by meter. The Chairman (Mr. Stevens) said he was strongly of opinion that this would be a better way. Mr. Parsloe explained that this course would be much too expensive. Mr. James (holding up a paper with "£15" on it, the price Mr. Joel charged for fixing the arc light, pole, &c.) said: "After that plaything, you are getting more enlightened." Mr. Wynne thought it preferable to issue an open advertisement, and then select the best system of lighting. It subsequently transpired that there was a probability of the Board purchasing the present plant; and as Mr. Parsloe had an important statement to make, they went into Committee. A long discussion ensued; and ultimately it was decided that a deputation should wait on the Gas Company, and tenders be advertised for.

## EDINBURGH AND DISTRICT WATER TRUST.

### Report on the Present and Future Supply.

The Engineers appointed by the Edinburgh and District Water Trust (Mr. James M. Gale, Engineer of the Glasgow Water Trust, Mr. G. H. Hill, of Manchester, and Mr. James Mansergh, of London) have lately presented their report, and the principal portions of it have been made public.

Dealing first with the capabilities of the existing works, the reporters state that in the South Pentlands district the watershed area is 3694 acres, and that the existing storeage reservoirs are: Glencorse, containing 359,375,000 gallons, and Logan Lee, containing 121,875,000 gallons, together 481,250,000 gallons. The quantity of water actually obtained from this district is 2,286,000 gallons a day in all but exceptionally dry years, or about 900,000 gallons less than if full storeage capacity were provided. To obtain this 900,000 gallons, a reservoir holding 350,000,000 gallons would have to be constructed, and ten miles of 15-inch pipe would have to be laid, the cost of which works is estimated at £75,000. Taking this into consideration, and not ignoring other circumstances which might arise if the district were more exhaustively utilized, the Engineers are of opinion that it will be prudent to leave things as they are, and rely on the 2,286,000 gallons a day as the available product of the South Pentlands watershed. In regard to North Pentlands district, they state that the aggregate contents of the three reservoirs in which water for supply is stored is 225,425,000 gallons. The mean yield from the North Pentlands area for the 184 days commencing July 1 and ending Dec. 31, was 44 cubic feet a minute, or 3,969,000 gallons a day. Adding to this the quantity from the South Pentlands, 2,286,000 gallons a day, the total becomes 6,255,000 gallons a day. Dealing next with the Moorfoot watershed, it is pointed out that from Gladhouse, Portmore, and Tweeddale Burn area, there was obtained 9,592,625 gallons per day, and from the Rosebery area 1,417,500 gallons a day—the total obtainable being 11,010,125 gallons. The statutory compensation from Moorfoot district is 3,532,583 gallons a day. Deducting this from the total collectable quantity—viz., 11,010,125 gallons per day—there remains for supply 7,477,542 gallons a day. Adding to this the Pentlands quantity in all but such abnormal droughts as 1870—viz., 6,255,000 gallons per day—a total of 13,732,542 gallons per day is arrived at.

Discussing the second point on which their opinion was sought—the existing requirements of the community, and whether any reduction in the consumption per head may be reasonably expected by adopting the best practical means of checking waste—the Engineers take the figures for 1889-90. At that time the total estimated population was 385,845. But the population supplied was given as 366,468; and this was the figure taken in making the calculations. The meter supplies showed the total quantity for the year to be 778,085,000 gallons, or an average of 2,131,740 gallons per day. An estimation by the Trust officials, apparently made on a reasonable basis, showed that 284,470,000 gallons in the year, or 779,370 gallons per day, were used in certain trades and in some public institutions; the water not being charged for by meter, but under special agreement. This was equivalent to 2·12 gallons per head per day; and adding the 779,370 gallons to the 2,131,740 gallons, they obtained a total for trade purposes of 2,911,110 gallons, or 7·94 gallons per head. The average quantity used per day for public sanitary conveniences, cab-wells, fountains, street-watering, sewer-flushing, &c., amounted to 470,000 gallons, equal to 1·28 gallons per head. Trade and public sanitary account together, therefore, for 3,381,110 gallons, or 9·22 gallons per head. From a statement prepared by Messrs. Leslie and Reid, it appeared that the average daily quantity supplied to Edinburgh and district in 1890 for all purposes was 14,794,000 gallons, and deducting the foregoing quantities—viz., 3,381,110 gallons—there was left as due to domestic consumption 11,412,890 gallons. Dividing this by the population (366,468), the quantity came out to 31·14 gallons per head per day. The trade and sanitary quantity being, as before shown, 9·22 gallons, the total present "take" per head for all purposes is 40·36 gallons. Proceeding, the Engineers say that they have learned that there is considerable preventible waste, and therefore that the take is in excess of the actual existing requirement. By repairs to fittings, the meter readings have been reduced in certain test districts to an equivalent of 2,358,607 gallons per day if extended over the whole district. The reduction of consumption in the test districts per head is 6·46 gallons per day, bringing the figures over the whole city down from 31·14 to 24·70 gallons. Under present conditions, however, this reduction cannot be maintained. Upon the second point in their instructions, they therefore say: 1. That the existing requirements of the whole community may be fairly taken at 31·94 gallons per head per day, or 11,704,988 gallons on a population of 366,468, as against the 14,794,000 gallons at present supplied. 2. That no real diminution of consumption can be effected without a substantial improvement in the fittings. 3. That if such improvement could be made at once, the present supply might be reduced to 31·94 gallons per head per day.

The third head of the instructions to the Engineers was as follows: "Whether the report can suggest any more effectual means for suppressing waste than those in operation by the Trustees at present." Before answering this question, they describe shortly the methods that are at present employed. There is a staff consisting of ten night inspectors and of seven day inspectors; the night men being occupied in discovering where waste takes place, and the daymen in following out the investigations, seeing to the repairs, &c. The total cost of this staff, including clerks and other incidental expenses, is £1530 a year. This system of inspection is very much better than day inspection alone, as the attention of the day inspectors is devoted exclusively to those places where waste of water has been discovered by the night men. They think, however, that no great reduction in the consumption of water can be ensured from a continuance of this method, although a small diminution may be expected. By placing nineteen representative districts upon meters, discovering thereby the waste and seeing the necessary repairs made, it is shown that a saving can be effected of 6·44 gallons per head per day. If this saving is to be extended over the whole area of supply, the reporters are of opinion that the following steps must be taken: (1) The whole must be placed under district meters. (2) The old defective fittings that are not conformable with the best practice in England, must be removed and replaced by better. Having had some experience in the use of different kinds of meters for localizing waste, they are of opinion that the "Deacon" system is the best; and they estimate that the capital cost of providing and putting in the necessary meters would be £25,000 or £26,000. That the annual expense of working the system, including interest on the capital, depreciation of meters, the wages of night inspectors, and incidental charges, would be about £3000. To this would have to be added the cost of day inspectors, which would probably amount to £1000 a year. In addition to this outlay, which would, of course, be borne by the Trust for the benefit of the whole community, the individual consumers or water ratepayers must supplement it by spending so much on their fittings as will put them in good order, and thus permanently prevent the waste discovered by the machinery set in motion by the Trust, who must be armed with sufficient powers to insist upon this being done.

The fourth head of inquiry submitted to the reporters was: "The probable future requirements, looking to the large increase in population and in the demand for trade purposes that has taken place since 1870." They cannot think that Edinburgh and its suburbs are likely to grow in the future at a less rate than 1 per cent. per annum; and they therefore take the increase during the 20 years' period between 1871 and 1891, as a measure of the future growth, which was equivalent to rather more than 15 per cent. per decade. Fifteen per cent. per decade is equivalent to 1·4074 per cent. per annum; and commencing with a population of 366,468 in 1891, the figure in 1901 will be 421,439. Notwithstanding the natural tendency towards an increased consumption for "domestic" and "public sanitary" purposes, they are of opinion that the use of the district meters, and the speedy and systematic improvement of the fittings will suffice to keep the requirements in the future under these two heads down to 24 gallons per person per day. The present take for trade "by meter" and under "special charges" is 7·94 gallons per head; "special charges" accounting for 2·12 gallons of this. In the nine years ended 1890, during which period the population supplied increased about 20 per cent., the consumption of water by meter practically trebled itself; being in 1880-81, 252,391,000 gallons, and in 1889-90, 780,368,000 gallons. The Engineers do not, however, believe that this rate of increase will be maintained. Under the heads of domestic and public sanitary supplies, they are of opinion that the requirements in 1901 will be 15,289,807 gallons. They make out that in a year of extreme drought the Trust will be able to supply 13,732,542 gallons a day, and that in 1897 they will want 14,059,962 gallons. According to this, therefore, the time has already arrived when the Trustees ought to be actively bestirring themselves in preparation for going to some new source of supply. A cycle of three dry years like 1842-4, or an abnormal drought such as that which happened in 1870, may recur without any warning. And, in the opinion of the Engineers, supposing the Trustees were to go to Parliament in the session of 1891-2, they could not confidently count on delivering water from a new source before the summer of 1900. At that date they would need 15,036,046 gallons a day, and might have only 13,732,542 gallons to furnish—showing a deficit of 1,303,504 gallons, and reducing the allowance of that time for all purposes from 36·18 to 33·04 gallons per head per day.

The reporters conclude a recapitulation of the foregoing by saying: "Under these circumstances, it is imperative that you proceed at once to provide for bringing in an additional supply. We therefore recommend that your Engineers proceed immediately to obtain such further information with regard to the several schemes already reported on by them as will enable us to advise jointly with them as to which of the schemes should be adopted."

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**The Consolidated Candelaria Company, Limited,** has been formed, with a capital of £100,000, in £1 shares, to acquire the undertakings of the Candelaria Water-Works and Milling Company, Limited, and of various mining companies, and to carry on generally the business of miners, smelters, &c., in America or elsewhere.

**The Gas Workers' and General Labourers' Union** held their second annual conference last week in Dublin. The proceedings were conducted in private; but we learn from the *Freeman's Journal* that the following have been elected officers of the Union: President, M Hutchings; General Secretary, W. Thorne; Assistant-Secretary, W. H. Ward; Treasurer, W. Byford; Organizers, P. Curran, V. H. Pickard; Auditors, F. Jenner, E. Aveling, and J. Canning. Six Trustees and an Executive of ten were also appointed.

**Buenos Ayres Water Supply and Drainage Company.**—The report of the Directors of this Company, lately issued, gives a full account of the agreement recently arrived at with the Argentine Government regarding the rescission of the concession. Under its terms, the Company will receive £6,324,404 in 5 per cent. bonds of the National Government charged upon the works and revenue. During the period in which the funding scheme for other Argentine securities remains in force, the coupons on the above-mentioned bonds will be paid in scrip of the new 6 per cent. loan. Previous to signing, it was necessary to enter into a conditional agreement with the contractors as to the appropriation of the bonds when received. The result of the agreement is that out of these bonds the preference shareholders will receive for every £100 in 6 per cent. shares £100 in 5 per cent. bonds. By the constitution of the Company, the preference shareholders have priority over the ordinary shares in respect of capital as well as dividends; and inasmuch as a 5 per cent. bond, unlikely to realize par, cannot exceed a 6 per cent. share, there must be a certain deficiency for the preference shares, and no surplus for the ordinary shares. The Directors deeply regret their inability to present a more acceptable proposal; but, in view of all the difficulties with which the concern is surrounded, and as the result of the experience of many months of continuous negotiations, they believe that it is expedient to accept this arrangement, although it inflicts heavy loss upon all interested. They further state that both agreements are subject to the approval of the shareholders.

## NOTES FROM SCOTLAND.

**From our Edinburgh Correspondent.**

EDINBURGH, *Saturday.*

The Dundee Gas Committee took a step on Monday, in the appointment of an independent analyst, which is to be approved or the opposite, according as it is viewed. It is well known that a great deal of the success of German manufacturers in the cheapening of production has resulted from the employment of a chemist on the works, and that the practice of employing chemists in commercial establishments is now very common in this country. For example, in nearly all the oil works in Scotland there is a laboratory, in which a staff of chemists is constantly engaged in the work of testing and research; and there is no doubt that it is owing to them, as much as to anything else, that Scotch paraffin, in its different forms of manufacture, owes its high position in the market. A gas-works, in that light, is therefore one of the most appropriate places for the exercise of chemical vigilance. Since competition with other illuminants became keen, wonders have been worked by inventors in the production of appliances for the manufacture and consumption of gas. But apparatus is not everything. Even such a simple article as a hammer, in the hands of a person unaccustomed to drive nails, is an ineffective as well as a somewhat dangerous tool. How much more so is that the case with the complicated parts of a gas-works! Sources of difficulty must be apparent to everyone. Indeed, they are not merely apparent; they thrust themselves upon the gas engineer at every turn. The meetings of local associations of gas managers bristle with such difficulties. I sometimes think, when I read the reports of their meetings, that members who cannot "carry their head," must leave those gatherings with more or less of a gloomy sense of the seemingly impenetrable mysteries which surround the simple process of distilling coal. When the average gas manager has listened, for example, to a carefully-prepared paper by someone he is accustomed to look up to, on a so-called improvement in the settings of a retort-bench, by which it is claimed that an increased yield or a better quality of gas is produced, or if he listens to one telling of how he gets quit of tar by placing the exhauster in a certain place, he probably feels that now the question which gave him so much trouble is settled. But what are his feelings when a speaker of as much eminence as the writer of the communication states that he attains equally good results by methods diametrically opposite? How is he to reconcile the two? The most probable reconciliation is in the different qualities of coal used. I need not particularize; but it must be that certain varieties of coal give off their products under widely different conditions, and it probably follows that gas engineers, generally by experience, find out what is the best method of treating the coal which their particular districts afford, without knowing much of the reason why. The obtaining of that knowledge would be a great acquisition to any gas manager or engineer; and it most assuredly can only be obtained by scientific research—that is, by analysis combined with practice. So far as the gas industry is concerned, an exhaustive chemical survey of the coals of the United Kingdom, with their adaptability, singly and in combination, for use in different forms of apparatus, would be an inestimable boon; but how far the published results of such an inquiry would affect the commercial value of certain varieties of coal is another question. If to do this for themselves is the object of the Dundee Gas Commission, then the appointment of Mr. Samuel Donald, assistant to Dr. Clark, of Glasgow, as their analyst, is commendable. Mr. Donald was recommended by Dr. Clark, as an old pupil who is well acquainted with the testing of gas and gas coal. He is to receive a salary of £150; and his duties are to keep the Commissioners posted up, by monthly reports, as to the values and qualities of the different coals in use, and to see that the quality of coal which is contracted for is delivered. It is expected that, in addition to his salary, there will be "some little expense" connected with his working. I should say that, if the appointment is to be efficiently filled, the expense will be considerable. If mere laboratory tests are to be taken, they are notoriously so unreliable that it would be a most crying injustice to Mr. M'Crae, the Engineer, to ask him to accept them as showing the duty of the different samples of coal. If, on the other hand, quantities of coal sufficient to give a working test are to be purchased here and there, current market rates will have to be paid, and the estimates for the year will be considerably disturbed. Mr. Donald's position is to be an independent one; and if he be granted a roving commission to purchase whichever coal he may take a fancy to, the exercise of his duties will be apt to clash with those of Mr. M'Crae. The question indeed arises whether the granting of such unlimited powers to the analyst may not make him practically manager of the gas-works; because, unless Mr. M'Crae be allowed to select his coal, he cannot be held responsible for the results. This independence of position of the analyst is likely to afford opportunities for conflict between the Manager and him; and the consequence will be that the gas undertaking will not be worked to its fullest capacity. A position subordinate to Mr. M'Crae would have been preferable, because it would have meant the giving of assistance to Mr. M'Crae, and not the controlling of him; and it is in this connection that the appointment cannot be said to be in all respects well advised. Besides, the proposal and appointment were carried through with such haste that the whole affair wears an air of suspicion.

If anything were needed to show that Dundee is one of the last places which required to appoint an analyst in order to bring prosperity to the gas undertaking, it is contained in the announcement to-day, that the accounts of the Commission for the past year have come out so well that it will not be necessary to raise the price of gas for the current year.

What is known as a special case—*i.e.*, a friendly suit—has been presented to the Court of Session on behalf of the Partick, Hillhead, and Maryhill Gas Company and the preference shareholders of the Company. The parties state that the price to be received for their undertaking from the Corporation of Glasgow—£202,500—with their other assets, will not be sufficient to repay the shares at their par value, but will be about 10 per cent. below that rate; and the principal question is whether the amount of the depreciation fund (about £17,000) is to be deducted from the price, or whether it should go into the revenue for the year, when, of course, it would be distributed among the ordinary shareholders only. The Company say it should be deducted; but the preference shareholders object. The preference shareholders also put forward a claim that they should be paid the amount of their capital in full before the ordinary shareholders receive anything. The case will be heard probably about six weeks hence.

The rather meagre prospects of electric lighting in Aberdeen which were disclosed recently, have had the effect of limiting the offerers to supply the light to two—the Brush Company and Mr. Miller, of Glasgow. The Gas Committee met this week; and it is stated that they saw their way to entertain only the offer of the Brush Company. That Company, however, make certain stipulations, one of which is that they must get the lighting of the streets into their contract, and another is that the Town Council must undertake not to materially alter the price of gas during the currency of the contract. The Gas Committee did not make up their minds as to what they should do; and they continued consideration of the subject until they should communicate with the Glasgow Municipal authorities upon it.

In my "Notes" last week, I made a brief reference to the report of the Consulting Engineers upon the water supply for Edinburgh; and mentioned that it would be more fully dealt with this week.* The reason these Engineers were consulted at all was that the Water Trustees were anxious to go in for an additional supply, and that objection, in very strong language, was taken to their proposals until the distributing plant was placed under the checking system of the Deacon meter, in order that it might be seen whether or not the present supply was inadequate. The Trustees were confident that, while a saving would be effected by the Deacon meters, it would not be sufficient to obviate the necessity for a new supply; and they were adverse to incurring both costs. The reporters have recommended both; and it is interesting to see the Deacon meter party climbing down and saying they never objected to a new supply. That is scarcely consistent with facts; the representation in support of the Deacon meter being that it would save half of the supply, and "at a moderate estimate" would make the existing supply last for from ten to fifteen years. The strictures of the reporters on the defective and faulty apparatus require some consideration. I understand they were impressed with the universality, in Edinburgh, of baths and water closets; in many instances working men's houses of only two apartments having both these conveniences. The complaint of the reporters is, not so much that the apparatus is leaky, as that it is of faulty, or old-fashioned, construction. This is explained by the fact that in Edinburgh, years ago, many of the houses were fitted with the then existing types of apparatus; and therefore that the proportion of old to modern apparatus is greater than in other towns where water conveniences are only of recent general introduction. They recommend that the old apparatus should be removed, or rendered incapable of waste. Now, the Trustees have for years been endeavouring to solve this very problem of how to prevent the careless or wasteful use of water among the more ignorant classes of the community. In the beginning of 1890, they proposed certain enactments which would have greatly helped them; but these were howled at so furiously that the Sheriff declined to sanction them. One gentleman, opposing a rule which would have enabled the Trustees to require satisfactory fittings to be introduced, informed the Sheriff that it would involve an outlay of a million and a half sterling; and that he thought "they had better apply the money to the introduction of a further supply of water." The editor of the *Scotsman* wrote: "It would almost seem as if the Trustees were endeavouring to push some particular patterns and qualities of water-fittings in the interests of manufacturers thereof. Who is to get the commission on such orders; for assuredly commission there will be? The recommendation of the reporters on the head of fittings is therefore useless, because it proposes that the Trustees should do a thing which they have already been refused the power of doing. The whole scheme may be judged by this recommendation as to fittings. If the renewal of them is to cost as much as a new supply, and if, after they have been renewed and Deacon meters fixed, it will still be necessary to find a new supply, it is apparent, seeing that no one is prejudiced by the waste of water, that the remedies proposed by the reporters will place the water supply on a satisfactory basis at double the cost which the Trustees propose." This looks very like the most complete vindication of the action of the Trustees which could be had; and most people will surely agree that the sensible course would be to introduce an abundant supply of water first, and to take time for the improvement of the water fittings, so as not to throw the burden all at once upon owners of property, but to allow them to introduce modern apparatus as the old wears out. If this policy were adopted, Deacon meters might be employed during the seven years it will take to introduce the new supply, should it be feared that the existing supply would not be equal to the demand till then. The Works Committee have resolved to recommend that the new supply be proceeded with, and that instructions should be given to the Consulting Engineers to report upon which of the three proposed schemes would be most suitable; but that the question of checking waste and improving the fittings be deferred in the meantime.

**From our Glasgow Correspondent.**

GLASGOW, *Saturday.*

The Dumbarton Corporation Gas Commissioners have resolved not to hand over to Glasgow, without compensation, the powers they possess to supply gas to the parish of Old Kilpatrick, which was included in the area of supply covered by the defunct Old Kilpatrick Gas Company, and subsequently by the Kilpatrick, Bowling, and Dalmuir Gas Company, whose works, goodwill, &c., passed into the hands of the Partick, Hillhead, and Maryhill Company when their Bill was in Parliament last summer. As may be remembered, the Glasgow Gas Commissioners, in resolving to buy up the last-named concern, are in a measure bound to take up all the Company's responsibilities in respect of the Old Kilpatrick, Bowling, and Dalmuir communities, or otherwise see that they are provided with gas. Some time

*An abstract of the report alluded to is given on another page.—ED. J.G.L.

ago they indicated to the Dumbarton Corporation their willingness either to hand over the Kilpatrick Gas-Works to them, at a price mutually satisfactory to both parties, or to take over the parish, so far as covered by the Dumbarton Gas Act; and it was thought that the friendly negotiations which were opened some weeks ago would have had a pacific and satisfactory termination before this time. But apparently that is not to be the case. A Dumbarton paper asks if the local Gas Commissioners will oppose "the big city" in their application to Parliament to acquire like powers with themselves to light the district referred to; and the writer goes on to remark that Dumbarton cannot be allowed to play "the dog in the manger" as they choose. Either they must themselves supply the gas to the district in question (which they would never dream of), or they must allow Glasgow the power. It is not a very dignified position to take up; and it is one that cannot long be permitted. In view of the fact that the Bill now being jointly promoted in Parliament by the Glasgow Corporation and the Partick, Hillhead, and Maryhill Gas Company, will again shortly come before the House of Lords Committee, a letter (said to be both long and strong) has been sent, I am told, by the Glasgow Town Clerk to the Dumbarton Gas Commissioners, who can scarcely have a leg to stand on when the matter comes before the Parliamentary Committee. I am informed that they have not secured *locus standi*; and if that is the case, their opposition to the Bill or refusal to concede the powers asked must fall to the ground.

Gas affairs in Stirling have just become a burning question among the municipal governors of that town. At last Monday's monthly meeting of the Town Council, there was submitted a letter from the Secretary of the Stirling Gaslight Company, stating that on April 28, the Directors resolved that, owing to the continued advance in the price of coal, the price of gas would be increased by 5d. per 1000 cubic feet after the survey of meters in May. Bailie Kinross, who, in the absence of Provost Yellowlees, occupied the chair, suggested that they had better remit the matter to the Lighting Committee, to consider and report. This suggestion was followed by a long discussion; in the course of which many very strong things were said in regard to the conduct of the Gas Company, and the quality of the gas supplied. Sundry remarks were made as to the high dividends paid to the shareholders over a number of years, and the rapacity of the Company; and threats to form a new company, adopt the electric light, and charge the Company a wayleave for their street mains were "trotted out." Then, on the question of the inferior quality of the gas supplied to the consumers, it was urged that the Trade Council should employ an expert to examine the gas and report upon it. Two of the local newspapers—one Tory and the other Radical—have dealt editorially with this *questio vexata*; and they both came down severely upon the Gas Company. The former says: "An increase of 5d., without any reason being assigned for it, is simply outrageous; and further, the gas is not worth the money." The latter paper makes the following remarks: "There is little doubt that what passed at the Council in regard to the gas question is a reflection, though a miniature one, of the general feeling of public resentment at the action of the Directors of the Stirling Gas Company in raising the price of gas. No one will grudge them a fair dividend on their investment; but the fact of the original £2 shares being now worth £8 2s. 6d., and eagerly snapped up at that, shows that the shareholders have no reason to complain of an inadequate return for their money. So long as they supplied good gas, and charged a fair price, the Company were allowed to work their little gold mine in peace; but an increase of 7d. per 1000 cubic feet in eighteen months, along with a lessened illuminating power, has raised the ire of the community; and this may have consequences which will cause the Directors to regret their greediness." I should mention that at the close of the discussion, the Town Council remitted the consideration of the matter to the Lighting Committee. It may be expected that the report at the next meeting of the Council will call forth equally severe reflections on the Gas Company, unless in the interim the proposal to advance the priceof gas is withdrawn.

A new ammonia-recovery plant has been erected in connection with the blast furnaces of the Shotts Iron Company—one of the oldest concerns of the kind in Scotland, after the Carron Company. The works for the recovery and treatment of the ammonia were commenced about a year ago; and they have been constructed on the newest and most improved system by the patentees, Messrs. R. and J. Dempster, of Manchester. After the engines, tubes, flues, &c. had all been thoroughly tested during the week, the works were formally started yesterday afternoon by Mr. John Dempster; and when the gas was put on, everything was found to work well and to be in perfect order.

Gas-stove exhibitions, with gas cookery demonstrations, are "in the air," so far as this part of the kingdom is concerned. The exhibition held this week, under the auspices of the Galston Gas Company, by Messrs. H. Darwin and Co., of this city, has been attended with a remarkable measure of success. At the last meeting of the Greenock Police Board, sitting as Gas Commissioners, there was submitted a proposal from Messrs. R. and A. Main to hold an exhibition of gas cookers, fires, &c. in the town, accompanied by a course of cookery lectures. The matter seems now to rest with the Finance Committee. Exhibitions in other places are being spoken of as prospective.

The price of Scotch pig-iron warrants has fluctuated this week between 52s. 6d. and 54s. 7d.; the close yesterday afternoon being 53s. 8d. per ton cash. There have also been considerable variations in the prices of Cleveland and hematite iron. The strained position of the last few weeks still continues. Very little new business of any kind is being done; and the "bears" are apparently just buying enough iron to square their settlements. The prices of special brands are not being influenced by the advance in the price of warrants. There are now 63 blast furnaces in actual operation, as compared with 86 at this time last year.

Prices of coal in the Glasgow district have shown little or no variation this week. Only a moderate amount of business has been done; the somewhat uncertain condition of the market inducing many of the buyers to hold back. Main sorts are quoted at 7s. 9d. to 8s. per ton; and splint coals at 8s. 6d. per ton f.o.b. Steam descriptions range in price from 10s. to 10s. 9d. per ton. Household coal is now in very limited demand; but the summer quotations can scarcely yet be said to be current.

## CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *May* 23.

**Sulphate of Ammonia.**—There is barely any quotable alteration; and it was not expected that the market would undergo much change during the holidays. A small steady business is passing, just sufficient to maintain values; and there are no symptoms of a decline, which is not likely to occur while there are purchasers of all prompt lots, as they appear on the market. At this season of the year, it requires no great effort to keep the market steady, and makers seem to be aware of this; and it may be added that, until greater activity prevails, an improvement cannot be predicted. The inquiries for summer and autumn delivery justify, however, the anticipation that prices for the next few months will not fall below present level; and any violent movements, should they occur, can only emanate from sudden fluctuations in the nitrate market. Spot quotations remain at £11; an advance would, however, be paid for parcels for June-September delivery. Nitrate slow at 8s. 7½d.

LONDON, *May* 23.

**Tar Products.**—With the exception of benzol, there is no great change in the values of these. Benzol, however, is weaker, and weakening. Anthracene is offering at lower prices; but very little business is transpiring. Pitch still rules about the same; but as the shipping season is practically over, there will be but little business doing in the meantime. Prices may be taken as follows: Tar, 27s. to 31s. Pitch, 34s. Benzol, 90 per cent., 4s.; 50 per cent., 2s. 11d. Toluol and solvent naphtha, 1s. 5d. Crude naphtha, 1s. 1d. Creosote, 1¼d. Carbolic crystals, 5¾d.; crude, 60's, 1s. 5d. Cresol, 8d. Anthracene, 30 per cent., "A" quality, 1s. 3d.; "B" quality, 11d.

**Sulphate of Ammonia.**—The demand still continues sluggish, and prices obtaining are from £10 17s. 6d. to £11. Gas liquor realizes from 5s. to 6s., according to strength and position.

**Northern Coal Trade.**—The coal trade of the North-eastern district has been brisker, in both the steam and the gas coal departments, because the supplies had been reduced by the holidays; and these are now being replaced. For best Northumbrian steam coal, the demand is still very strong; and the price is maintained at from 12s. 6d. to 13s. per ton, according to the position of the colliery. Most of the pits are unable to take early orders; but the demand is expected to be easier, now that less is being sent to Belgium. Gas coal is firm, with a large inquiry for export. The price varies considerably; and from 9s. 1d. to 10s. per ton, free on board, may be taken as the current quotation for best gas coal for prompt delivery. Household coal is naturally quiet at this time of the year; and it is expected that the summer reduction in price may be looked for soon. Manufacturing coal is steady, with a good demand; but bunker coal is easy—many steamships being still idle in consequence of the unremunerative rates of freight. For coke there is a little more firmness; but gas coke is unaltered in price, and the lessened production is better taken up.

**Electric Lighting for Cambridge.**—At the last meeting of the Cambridge Town Council, a lengthy report was presented by the Electric Lighting Committee, in which they described the electric lighting works of the Bradford Corporation and of the Newcastle and District Electric Lighting Company, which a Sub-Committee had visited. The Sub-Committee invited one of the contractors who had sent in tenders to give them an estimate for a plant on the lines of that at Newcastle—differing from it only on two points, one of which was that the voltage should be 2000 instead of 1000. He computed the total cost of the plant at £8731; of the necessary buildings, at £3000; and extras, including an artesian well, at £1768—making the total capital outlay £13,500 for building and equipping the generating station. This would be capable of maintaining 3750 16-candle power lamps lighted at one time, with one 75-unit plant in reserve. Added to the above sum would be the cost and laying of mains, £8000; of transformers and meters, £4000; and land, £1050—making the total expenditure £26,550. By this outlay, it was stated that an annual sum of £6562 could be earned. The Committee recommended that the report should be adopted, and that Professor W. Garnett, of Newcastle, should be appointed to act as Consulting Electrical Engineer in carrying out the scheme. This, however, was not agreed to by the Council; but an amendment was carried postponing consideration of the matter until a full report on the tenders and all documents and correspondence relating thereto had been communicated to the members.

**The Bolton Corporation and the Apportionment of Gas Profits.**—At a special meeting of the Bolton Town Council held last Wednesday, a discussion took place with regard to the apportionment of the gas profits for the past financial year. (Particulars as to the working of the gas undertaking during the period named were given in the JOURNAL a fortnight ago.) In the first place, the Gas Committee proposed to hand over the sum of £15,000 in relief of the rates; but the Finance Committee, being anxious to avoid any increase in the rates this year, asked for a larger sum—at the same time reducing slightly the estimates in several other departments. The Gas Committee, having reconsidered the balance-sheet, resolved that £4892 14s. of profit balance on the revenue account should be transferred to the reserve fund, and £18,000 used in relief of the rates. Several members disagreed with the action of the Committee, and said that, as the consumers had created the profits, they were entitled to the advantage in the way of a reduction in price. Others held that it was most necessary the heavy capital account on the gas-works should be reduced, particularly in view of the fact that electricity is coming to the front. Alderman Miles, Chairman of the Gas Committee, said that, as nearly the whole of the ratepayers were consumers, they obtained the advantage by the money being employed in relief of the rates. The action of the Committee in handing over £18,000 with the view of preventing an increase in the rates of the town was one he thoroughly approved of, and one he believed the ratepayers would applaud. The Committee's recommendation was agreed to.

**Messrs. J. and H. Robus** are now engaged in erecting retorts upon the inclined system for the Oxford Gas Company, who have placed with them the contract to supply the whole of the necessary plant and machinery. The firm are also erecting complete a large number of arches and retort-settings on the Nugent principle at the Norwich Gas-Works; as well as carrying out retort and other extensions and renewals at Bedford, Carlisle, Cromer, Faversham.

**The Dispute at the Coventry Gas-Works.**—The Gas Committee of the Coventry Corporation, at their monthly meeting last Wednesday had before them the question of the recent dispute at the gas-works. The Committee had previously met a deputation of the men to hear from them the grounds of their dissatisfaction; and it was decided to grant a small increase in the wages of those who were considered to be underpaid. The dispute has therefore been amicably settled.

**Cookery Lectures at Romsey.**—Miss E. Williams, first-class diplomée of the National Training School, South Kensington, on Wednesday, Thursday, and Friday of last week delivered two lectures daily on "Cooking by Gas," at the Corn Exchange, Romsey, Hants.; having been specially engaged to do so by the Romsey Gas Company. The cooking-stoves of the Davis Gas-Stove Company, Limited, were used; and the lectures were attended by appreciative audiences. The result has been the adoption of gas-stoves by several consumers.

**The Dangers of Spirit-Lamps.**—Just after midnight last Saturday, a fire broke out at the residence of Lord Romilly, in Egerton Gardens, Brompton, which unhappily caused the deaths of his Lordship and two women servants. It is probable that the exact cause of the outbreak will never be known; but there does not appear to be any reason for doubting that his Lordship accidentally overturned a large spirit-lamp in the drawing-room on the first floor, and was rendered insensible by the fumes of the blazing oil and the smoke. In Captain Shaw's official report the fire is attributed to the upsetting of a spirit-lamp.

**The Retrospective Increase in the Price of Gas at Nottingham.**—At the Nottingham County Court last Friday, a case was heard, having reference to the agitation in the borough regarding the increase in the price of gas in July last; the plaintiff being a Mr. Slack, and the defendants the Nottingham Corporation. From the evidence, it seemed that the claim was for 2s. 9d. overpaid to the Corporation for gas by a person named Saxby, who had assigned his interest in the claim to the plaintiff for a shilling. The Corporation supplied to Saxby in the last Midsummer to Michaelmas quarter 16,800 cubic feet of gas for £2 2s., which was at the rate of 2s. 6d. per 1000 cubic feet or 2d. per 1000 feet more than was the current rate. The measurement was not disputed. On June 12 the Gas Committee met, and agreed to recommend to the Council the raising of the price by 2d. per 1000 feet; and the Council adopted the Committee's recommendation on July 17. It was contended that the resolution of the Council, passed on July 17, could not apply to gas consumed before that date; and the Corporation could not raise the price of an article which had been already consumed. Mr. Saxby stated that Slack induced him to assign the claim; and he should not have been present had he not been subpœnaed. The plaintiff pointed out that what he objected to was not the increase in the price of gas, but the manner in which the rise had been made—that it was retrospective. He had acted in this manner partly for money, and partly for philanthropy. The amount he had received was about £200; but he had given £100 worth of time. Mr. Stanger, for the Corporation, said the claim was paltry and vexatious; the plaintiff having acted only for his own pecuniary benefit. Mr. Saxby had, he contended, no claim to assign to Slack, because he himself had, at that time, made no application for a return of the 2s. 9d., which, it was now alleged, he had been overcharged. Therefore, there was no cause of action. His Honor gave a verdict for the defendants with costs.

## GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1016.)

| Issue. | Share | When ex-Dividend. | Dividend or Div. & Bonus. | NAME. | Paid per Share | Closing Prices. | Rise or Fall in Wk. | Yield upon investment. |
|---|---|---|---|---|---|---|---|---|
| £ | | | p. c. | GAS COMPANIES. | | | | £ s. d. |
| 590,000 | 10 | 10 Apl. | 10½ | Alliance & Dublin 10 p. c. | 10 | 16—17 | .. | 6 3 6 |
| 100,000 | 10 | „ | 7½ | Do. 7 p.c | 10 | 11½—12½ | .. | 6 0 0 |
| 300,000 | 100 | 2 Jan. | 5 | Australian (Sydney) 5 % Deb. | 100 | 100—108 | .. | 4 12 7 |
| 100,000 | 20 | 27 Nov. | 8 | Bahia, Limited | 20 | 13—15 | .. | 10 13 4 |
| 200,000 | 5 | 13 May. | 7½ | Bombay, Limited | 5 | 6½—7½ | .. | 5 7 1 |
| 40,000 | 5 | „ | 7½ | Do. New | 4 | 4½—5½ | .. | 5 14 1 |
| 380,000 | Stck. | 26 Feb. | 12½ | Brentford Consolidated | 100 | 217—222 | .. | 5 10 4 |
| 125,000 | „ | „ | 9½ | Do. New | 100 | 158—163 | .. | 5 13 6 |
| 220,000 | 20 | 12 Mar | 11½ | Brighton & Hove Original | 20 | 40—42 | .. | 5 9 6 |
| 320,000 | 20 | 10 Apl. | 11½ | British | 20 | 44—46 | + ⅛ | 4 17 10 |
| 50,000 | 10 | 12 Mar. | 11 | Bromley, Ordinary 10 p. c. | 10 | 18—20 | .. | 5 10 0 |
| 39,000 | 10 | „ | 8 | Do. 7 p. c. | 10 | 13—15 | .. | 5 6 8 |
| 328,750 | 10 | 13 Nov. | 6 | Buenos Ayres (New) Limited | 10 | 9½—10½ | —½ | 5 14 3 |
| 200,000 | 100 | 2 Jan. | 6 | Do. 6 p. c. Deb. | 100 | 100—103 | .. | 5 16 7 |
| 150,000 | 20 | 26 Feb. | 8 | Cagliari, Limited | 20 | 25—27 | .. | 5 18 6 |
| 550,000 | Stck. | 10 Apl. | 13⅜ | Commercial, Old Stock | 100 | 260—265 | .. | 5 3 9 |
| 130,000 | „ | „ | 10⅔ | Do. New do. | 100 | 198—203 | .. | 5 5 11 |
| 130,000 | „ | 30 Dec. | 4½ | Do. 4½ p. c. Deb. do. | 100 | 121—126 | .. | 3 11 5 |
| 557,320 | 20 | 30 Dec. | 13 | Continental Union, Limited | 20 | 49½—50½ | .. | 5 2 11 |
| 242,680 | 20 | „ | 13 | Do. New '69 & '72 | 14 | — | .. | — |
| 200,000 | 20 | „ | 10 | Do. 7 p. c. Perf. | 20 | 37—39 | .. | 5 2 6 |
| 75,000 | Stck. | 25 Mar. | 10 | Crystal Palace District | 100 | 195—205 | .. | 4 17 7 |
| 486,090 | 10 | 28 Jan. | 4† | European, Limited | 10 | 20—21 | .. | — |
| 354,660 | 10 | „ | 4† | Do. Partly paid | 7½ | 14½—15½ | .. | — |
| 5,470,630 | Stck. | 12 Feb. | 13 | Gaslight & Coke, A, Ordinary | 100 | 240—244 | .. | 5 6 6 |
| 100 000 | „ | „ | 4 | Do. B, 4 p. c. max. | 100 | 97—100 | + 1 | 4 0 0 |
| 665,000 | „ | „ | 10 | Do. C, D, & E, 10 p.c. Pf. | 100 | 255—260 | .. | 3 16 11 |
| 30,000 | „ | „ | 5 | Do. F, 5 p. c. Prf. | 100 | 120—125 | .. | 4 0 0 |
| 60,000 | „ | „ | 7½ | Do. G, 7½ p. c. do. | 100 | 175—180 | .. | 4 3 4 |
| 1,300,000 | „ | „ | 7 | Do. H, 7 p. c. max. | 100 | 160—164 | .. | 4 5 4 |
| 463,000 | „ | „ | 10 | Do. J, 10 p. c. Prf. | 100 | 253—258 | .. | 3 17 6 |
| 476,000 | „ | „ | — | Do. K, 6 p. c. Prf. | 100 | 152—157 | .. | 3 16 6 |
| 1,061,150 | „ | 12 Dec. | 4 | Do. 4 p. c. Deb. Stk. | 100 | 113—118 | .. | 3 7 10 |
| 294,850 | „ | „ | 4½ | Do. 4½ p. c. do. | 100 | 122—126 | .. | 3 11 5 |
| 908,000 | „ | „ | 6 | Do. 6 p. c. do | 100 | 165—170 | .. | 3 10 6 |
| 3,800,000 | Stck. | 13 May. | 12 | Imperial Continental | 100 | 224-229 | —3½ | 5 4 9 |
| 75,000 | 5 | 12 Dec. | 6 | Malta & Mediterranean, Ltd. | 5 | 4⅞—5⅛ | + ⅛ | 5 14 3 |
| 560,000 | 100 | 1 Apl. | 5 | Met. of Melbourne, 5 p. c. Deb. | 100 | 110—112 | .. | 4 9 3 |
| 541,920 | 20 | 27 Nov. | 6½ | Monte Video, Limited. | 20 | 19—20 | .. | 3 10 0 |
| 150,000 | 5 | 27 Nov | 10 | Oriental, Limited | 5 | 9—9½ | .. | 5 5 3 |
| 60,000 | 5 | 25 Mar. | 7 | Ottoman, Limited | 5 | 4—5 | .. | 7 0 0 |
| 166,870 | 10 | 26 Feb. | 2 | Pará Limited. | 10 | 3—4 | .. | — |
| 420,000 | 100 | 4 May | 6 | People's Gas of Chicago—1st Mtg. Bds. | 100 | 92—97 | .. | 6 3 9 |
| 500,000 | 100 | 1 Dec. | 16 | 2nd Do. | 100 | 93—98 | .. | 6 2 5 |
| 150,000 | 10 | 28 Apl. | 10 | San Paulo, Limited | 10 | 15⅞—16⅛ | .. | 5 1 2 |
| 500,000 | Stck. | 26 Feb. | 15½ | South Metropolitan, A Stock | 100 | 282—287 | .. | 5 8 0 |
| 1,350,000 | „ | „ | 12 | Do. B do. | 100 | 235—240 | .. | 5 0 0 |
| 166,500 | „ | „ | 13 | Do. C do. | 100 | 242—250 | .. | 5 4 0 |
| 678,000 | „ | 30 Dec. | 5 | Do. 5 p. c. Deb. Stk. | 100 | 141—145 | .. | 3 9 0 |
| 60,000 | 5 | 12 Mar. | 11½ | Tottenham & Edm'nton, Orig. | 5 | 11—13 | .. | 4 8 5 |
| | | | | | | *Ex div. | | |
| | | | | WATER COMPANIES. | | | | |
| 729,221 | Stck. | 30 Dec. | 10 | Chelsea, Ordinary | 100 | 260—270 | .. | 3 14 1 |
| 1,720,560 | Stck. | 10 Apl. | 8 | East London, Ordinary | 100 | 212—217 | .. | 3 13 9 |
| 544,440 | „ | 30 Dec. | 4½ | Do. 4½ p. c. Deb. Stk. | 100 | 140—145 | .. | 3 2 0 |
| 700,000 | 50 | 12 Dec. | 9 | Grand Junction | 50 | 115—120 | .. | 3 15 6 |
| 708,000 | Stck. | 12 Feb. | 10½ | Kent | 100 | 265—270 | .. | 3 17 10 |
| 1,043,800 | 100 | 30 Dec. | 9½ | Lambeth, 10 p. c. max. | 100 | 240—244 | —1½ | 3 17 11 |
| 406,200 | 100 | „ | 7½ | Do. 7½ p. c. max. | 100 | 197—202 | +2 | 3 14 3 |
| 260,000 | Stck. | 25 Mar. | 4 | Do. 4 p. c. Deb. Stk. | 100 | 118—123 | .. | 3 5 0 |
| 500,000 | 100 | 12 Feb. | 12½ | New River, New Shares | 100 | 345—355 | .. | 3 8 4 |
| 1,000,000 | Stck. | 28 Jan. | 4 | Do. 4 p. c. Deb. Stk | 100 | 125—128 | .. | 3 2 6 |
| 902,300 | Stck. | 12 Dec. | 7 | S'thwk & V'xhall, 10 p. c. max. | 100 | 170—175 | .. | 4 0 0 |
| 126,500 | 100 | „ | 7 | Do. 7½ p. c. do. | 100 | 165—170 | .. | 4 2 4 |
| 1,155,066 | Stck | 12 Dec. | 10 | West Middlesex. | 100 | 255—265 | .. | 3 15 6 |

† Interim dividend.


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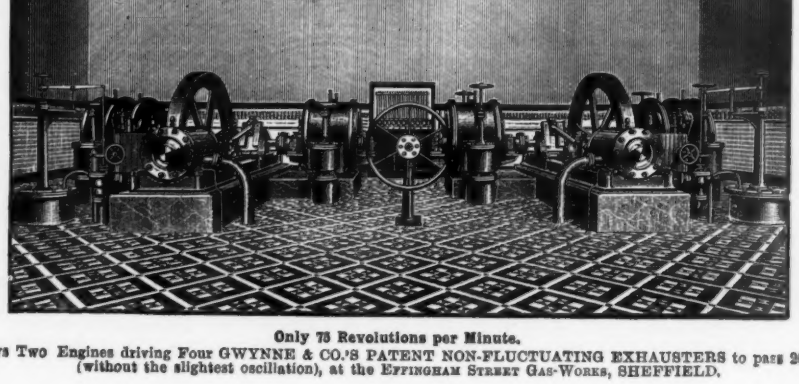

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**W. C. HOLMES & Co.,** Huddersfield, AND 80, CANNON STREET, LONDON, Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. 1040 of this week's issue.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

**J. & J. BRADDOCK,** Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock, Oldham."

TUBES.

**FOR Gas, Steam, and Water;** Galvanized, White Enamelled, and Hydraulic Tubes, &c.
JOHN SPENCER, Globe Tube Works, WEDNESBURY, and 14, Great St. Thomas Apostle, LONDON.

**COZE'S** Automatic Apparatus for CHARGING AND DISCHARGING GAS-RETORTS. For Illustrated Advertisement of this System, see p. 861.
Inquiries should be addressed to THE AUTOMATIC COAL-GAS RETORT COMPANY, LIMITED, 86-88A, LEADENHALL STREET, E.C.

**RAILWAY Tanks on Hire.**
Address BROTHERTON AND CO., Ammonia and Tar Distillers, LEEDS.

**MESSRS. ROBUS,** 20, Bucklersbury London, E.C., require for their London Office, an ASSISTANT DRAUGHTSMAN.
Intending applicants should forward copies of testimonials, and state salary required, on or before June 1.

**WANTED,** a small Second-hand Beale EXHAUSTER.
State full particulars to J. HARDMAN & Co., Tunstall STOKE-ON-TRENT.

**WANTED,** a set of Four Second-hand PURIFIERS, 6 feet or 7 feet square, with 6-inch connections; or a set of three 8 feet square.
Price and full particulars to J. MACKENZIE, YARM-ON-TEES.

**FOR SALE**—"The Journal of Gas Lighting," from June, 1886. Clean; unbound.
Offers to S. E. SHIRES, Bradley Green, CONGLETON.

**FOR SALE**—A Second-hand 8-inch CENTRE-VALVE with CONNECTIONS, complete and in good condition.
For price, &c., apply to the WATER AND GAS COMPANY, LOWESTOFT.

**FOR SALE**—"King's Treatise on the Manufacture of Coal Gas," Three volumes, half Morocco, equal to new.
Apply to Mr. J. B. HARVEY, Oxford Road, COLCHESTER.

**FOR SALE,** very cheap—A second-hand patent ROTARY WASHER, in good condition. Capacity, quarter of a million per diem. Also a STATION GOVERNOR of the same capacity.
For price, &c., either as they stand, or overhauled and put in good working order, apply, by letter, to No. 1957, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SPENT OXIDE AND RECOVERED SULPHUR.

**FOR SALE**—About 1000 tons of Spent OXIDE, containing 50 per cent. of Sulphur; also 30 tons of RECOVERED SULPHUR. Offers invited for either or both.
Address the MANAGER, Gas-Works, ROCHDALE, who will forward samples on application.

**COLNE AND MARSDEN LOCAL BOARD.**

TENDERS FOR BOILER.

**THE Gas Committee invite Tenders for** the supply and erection of a STEEL BOILER (Lancashire type), 23 ft. by 6 ft. diameter (working pressure 60 lbs.).
Tenders to be sent in to the undersigned on or before June 1.
H. SIMMONDS, Engineer.
Gas-Works, Colne,
May 13, 1891.

**COLNE AND MARSDEN LOCAL BOARD.**

TENDERS FOR SCRUBBER-WASHER.

**THE Gas Committee invite Tenders for** the supply and erection of a SCRUBBER-WASHER of the capacity of 30,000 cubic feet per hour.
Tenders to be sent in to the undersigned on or before June 1.
H. SIMMONDS, Engineer.
Gas-Works, Colne,
May 13, 1891.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

**BALE, BAKER, & CO.,** direct Importers from Ireland. Sample and Price on application.
OXIDE PAINT, SULPHURIC ACID, & Chemicals.
120 and 121, NEWGATE STREET, LONDON, E.C.

SULPHURIC ACID.

**JOHN NICHOLSON & SONS,** Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

**JOHN RILEY & SONS,** Chemical Manufacturers, Hapton, near Accrington, are MAKERS of SULPHURIC ACID, from Brimstone, for Sulphate of Ammonia making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol. References given to Gas Companies.

**HUTCHINSON BROTHERS,** Barnsley, Gas Engineers and Contractors, Makers of Wet and Dry Gas-Meters and General Gas Apparatus, Sulphate of Ammonia Plant, Lead Saturators, Tanks, &c., Tools and Sundries.

**OXIDE OF IRON.** Genuine Natural Bog ORE. QUALITY AND CONDITION GUARANTEED. Any quantity supplied at lowest rates.
D. M. NELSON AND SONS, GLASGOW. Telegraphic Address: "Gas Glasgow." Depôts throughout England and Scotland.

**SHREWSBURY GASLIGHT COMPANY.**

TENDERS FOR COAL.

**THE Directors of the Shrewsbury Gas**light Company invite TENDERS for the supply of about 13,000 tons of High-Class Screened GAS COALS, and about 650 tons of good ENGLISH CANNEL, to be delivered free at the Great Western or London and North-Western Goods Yard, Shrewsbury during the year commencing July 1, 1891, and ending June 30, 1892.
The Directors reserve to themselves the right to divide the quantity into two or more Contracts, and do not bind themselves to accept the lowest or any tender.
Tenders must be made on forms (containing further particulars) which may be obtained on application at the Company's Works, or by post, and must be sent to the undersigned, on or before the 20th day of June, 1891.
By order,
WM. BELTON, Assoc. M. Inst. C.E.,
Secretary and Manager.
Gas-Works, Shrewsbury,
May 19, 1891.

**SHREWSBURY GASLIGHT COMPANY.**

DISPOSAL OF SURPLUS TAR.

**THE Directors of the above Company** are desirous of receiving TENDERS for the purchase of the surplus TAR made at their Works during the year commencing July 1, 1891.
The estimated quantity for disposal is about 900 tons per annum.
Tenders must be made on forms (containing further particulars) which may be obtained on application at the Company's Works, or by post, and must be sent in to the undersigned not later than the 20th day of June, 1891.
The Directors do not bind themselves to accept the highest or any tender.
By order,
WM. BELTON, Assoc. M. Inst. C.E.,
Secretary and Manager.
Gas-Works, Shrewsbury,
May 19, 1891.

**MERTHYR TYDFIL GAS COMPANY.**

TENDERS FOR COAL.

TO COLLIERY PROPRIETORS.

**THE Directors of the Merthyr Tydfil** Gas Company require TENDERS for the supply over One year of about 5000 tons (or such other quantity as may be agreed upon) of the best quality large well-screened GAS COAL, to be delivered on their Railway Siding (Taff Vale Railway), Gas-Works, Picton Street, Merthyr Tydfil, in such quantities as the Manager may from time to time require during a period commencing on the 1st of July next.
Payments will be made by net cash monthly for previous month's deliveries.
Further particulars, with specification and form of tender, may be obtained on application to the undersigned.
Tenders must be on the Company's printed form, otherwise they will not be considered; and the tender, sealed, and endorsed "Coal," specifying the description of coal, and the pit at which it is to be raised, must be addressed to T. J. Evans, Esq., J.P., the Chairman of the Directors, and delivered at the Gas Offices, Merthyr Tydfil, not later than Ten o'clock a.m. on Tuesday, the 9th of June proximo.
The Directors do not bind themselves to accept the lowest or any tender.
By order of the Board of Directors.
JOHN L. COCKER,
Secretary and Manager.
Gas Offices, Gas-Works,
Merthyr Tydfil, Glamorganshire,
May 18, 1891.

**RADCLIFFE AND PILKINGTON GAS COMPANY.**

TO TAR DISTILLERS.

**THE Directors of this Company invite** TENDERS for the purchase of 700 tons of the surplus TAR now in stock and to be produced at their Works in Radcliffe during the ensuing year.

Particulars may be obtained from the undersigned, to whom endorsed tenders must be delivered not later than Thursday, the 4th of June next.

JAMES BRADDOCK,
Manager and Secretary.

Gas-Works, Radcliffe,
May 14, 1891.

**ROCHESTER, CHATHAM, AND STROOD GAS-LIGHT COMPANY.**

SUPPLY OF COALS.

**THE Directors of the above Company** invite TENDERS for the supply of 39,300 tons of AS COALS to be delivered in the year commencing he 1st of July next, and ending the 30th of June, 1892.

Particulars and copy of form of contract may be had on application to

WILLIAM SYMS,
Secretary and Manager.

Gas Office: 58, High Street, Rochester,
May 14, 1891.

MIRFIELD GAS COMPANY.

**THE Directors of this Company are** prepared to receive TENDERS for the surplus TAR and AMMONIACAL LIQUOR produced at the above Company's Works for One year from the 1st day of July next.

For Tar state price per ton at the Works.

For Ammoniacal Liquor state price per ton, per oz. strength from 8 to 12 oz., tested by Wills's Test, delivered either at the Company's Works, or into Contractor's boats.

Tenders to be sent in, endorsed "Tender for Tar and Ammoniacal Liquor," not later than Monday, the 1st day of June, 1891, addressed to

SAMUEL DAY,
Secretary.

Gas-Works, Ravensthorpe, *via* Normanton,
May 13, 1891.

IRON ROOF.

**THE Directors of the Preston Gas** Company are prepared to receive TENDERS for the supply and erection of the IRONWORK, &c., for a ROOF over the Retort-House of their Works, situate in Moor Lane, in Preston.

Plans and specification may be seen at the Office of the undersigned, on and after Wednesday, the 13th inst.

Tenders, addressed to the Chairman, and endorsed "Tender for Roof," must be delivered on or before Wednesday, the 3rd day of June next.

HENRY GREEN, Engineer.

May 4, 1891.

**CAMBRIDGE UNIVERSITY AND TOWN GAS-LIGHT COMPANY.**

TO TAR DISTILLERS AND OTHERS.

**THE Directors of this Company will,** at their Meeting on June 4, be prepared to receive TENDERS for the surplus TAR and the whole of the AMMONIACAL LIQUOR produced at these Works, for a period of One year, from July 1 next ensuing.

Further particulars may be had from the undersigned.

WILLIAM DUESBURY, Manager.

Gas-Works, Cambridge, May 5, 1891.

TENDERS FOR THE SUPPLY OF GAS COAL.

**THE Widnes Local Board invite Tenders** for the supply of about 14,000 tons of GAS COAL (Slack "through and through," or screened Coal), to be delivered at the Gas-Works, Widnes.

Conditions and forms of tender may be obtained from Mr. Carr, Gas Engineer, Widnes.

Tenders to be addressed to the Chairman of the Gas Committee, endorsed "Gas Coal," and delivered to the undersigned not later than Eleven a.m., on Monday, the 1st day of June.

The Board do not bind themselves to accept the lowest or any tender.

H. S. OPPENHEIM,
Clerk.

Town Hall, Widnes,
May 13, 1891.

TAR.

**THE Directors of the Reading Gas** Company invite TENDERS for the purchase of their TAR for One year, commencing on the 1st of July next.

Specifications for the contracts will be forwarded on application. Rail and Water communication direct to the Works.

Tenders, endorsed "Tender for Tar," must be delivered not later than Monday, the 1st of June, to

ARTHUR H. CANE,
Secretary.

Office: 22, Market Place, Reading,
May 12, 1891.

**PETERBOROUGH GAS COMPANY.**

TENDERS FOR COAL.

**THE Directors of the above Company** invite TENDERS for the supply of best screened GAS COAL and NUTS for One year, commencing the 1st of July next.

Form of tender and conditions may be obtained on application to the undersigned.

Tenders to be sent in by the 8th of June next, endorsed "Coal," and addressed to the Chairman of the Company.

The Directors do not bind themselves to accept the lowest or any tender.

JOHN BARTON,
Secretary and Manager.

Gas-Works, Peterborough,
May 15, 1891.

CROSSGATES, HALTON, AND SEACROFT GAS COMPANY, LIMITED.

**THE above Company have for Sale one** of PEEBLES' MERCURIAL GOVERNORS, with 3-inch Connections, which has never been used. Will be sold cheap.

Price and part culars on application.

JAMES LEE,
Manager.

CROSSGATES, HALTON, AND SEACROFT GAS COMPANY, LIMITED.

**THE above Company would be glad to** hear of an ENGINE and EXHAUSTER (second-hand), to pass from two thousand (2000) to three thousand (3000) cubic feet per hour, either combined or otherwise; also a STEAM-BOILER, about 3 or 4 horse power, of the vertical type.

Particulars may be obtained from the undersigned, to whom lowest price should be sent at once.

JAMES LEE,
Manager.

TENDERS FOR COAL.

**THE Directors of the Derby Gaslight** and Coke Company are prepared to receive TENDERS for the supply of 40,000 tons of COAL or NUTS.

Particulars may be obtained from the undersigned.

Sealed tenders, endorsed "Tender for Coal," and addressed to the Chairman of the Finance Committee, must be delivered at the Offices of the Company, Friar Gate, on or before Monday, the 1st day of June next.

RICHARD FISHER,
Secretary.

May 15, 1891.

TENDERS FOR GAS COAL.

**THE Directors of the Exmouth Gas** Company invite TENDERS for the supply of about 1900 tons of screened or unscreened ARLEY, HOLMSIDE, or NEW PELTON COAL, or best NEWCASTLE or other good GAS COAL.

Tenders to be for price f.o.b.; also price delivered free at Exmouth Docks, between the 1st of July next, and the 30th of June, 1892, accompanied by working analysis.

Sealed tenders, addressed to the Chairman, and endorsed "Tender for Coal," to be sent in not later than the 15th day of June next.

No tender necessarily accepted.

By order,
JAMES T. FOSTER,
Secretary.

Exmouth,
May 14, 1891.

**COUNTY BOROUGH OF ST. HELENS.**
(GAS DEPARTMENT.)

GAS COALS.

**THE Gas Committee of the St. Helens** Corporation invite TENDERS for the supply of COAL and CANNEL for gas-making purposes at their Works, for One or Two years, commencing the 1st of July, 1891.

Forms of tender and all particulars may be obtained on application to the undersigned.

The tenders, endorsed "Gas Coals," are to be delivered on or before Tuesday, the 9th of June next, addressed to the Chairman of the Gas Committee, Warrington Old Road, St. Helens.

The Committee reserve to themselves the right to decline the lowest or any tender.

SAMUEL GLOVER,
Engineer and Manager.

Gas-Works, St. Helens,
May 23, 1891.

LURGAN GAS, LIGHT, AND CHEMICAL COMPANY LIMITED.

**THE Directors are anxious to procure** TENDERS for the supply of 2750 tons of best screened GAS COAL, delivered into Lighters *ex* Ship at Belfast, free of all charges.

Delivery of 2000 tons will be taken before the 1st of November next; the remainder to be delivered at such times before the 1st of March, 1892, as may be required.

Vessels carrying from 250 to 350 tons can at once deliver into Lighters, and these Lighters be back for a further cargo within a period to be arranged.

Tenders (in sealed envelope), accompanied by reference to Gas-Works using the Coal offered, should reach me not later than Ten o'clock in the forenoon of Monday, the 1st of June next.

The Directors do not bind themselves to accept the lowest or any tender.

FRED. W. MAGAHAN,
Secretary.

Gas-Works, Lurgan,
May 5, 1891.

**CARDIFF GASLIGHT AND COKE COMPANY.**

TENDERS FOR COALS.

**THE Directors of the above Company** are prepared to receive TENDERS for a supply of 50,000 tons of best well-screened large GAS COALS, to be delivered between July, 1891, and the 30th of June, 1892, in monthly quantities, in accordance with the specification.

Parties tendering may do so for the whole quantity or for quantities from 5000 tons upwards.

Forms of tender and specification of monthly deliveries may be obtained on application to Mr. H. Morley, the Company's Engineer.

Sealed tenders to be sent to the undersigned not later than Thursday, the 4th day of June next, addressed to the Chairman of the Company, and endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order,
GEORGE CLARRY,
Secretary.

Gas Offices, Cardiff,
May 2, 1891.

LEIGH LOCAL BOARD.

**THE Gas Committee of the Leigh Local** Board invite TENDERS for the supply of GAS COAL or NUTS, for a period of One year, commencing on the 1st of July next.

The quantity required is 7000 tons.

Specification and all particulars may be had from the undersigned.

Sealed tenders, endorsed "Coal," and addressed to Mr. Alderman Thorp, Chairman, to be delivered at the Town Hall, Leigh, not later than Monday, the 15th of June next.

The lowest or any tender not necessarily accepted.

ALFRED T. FLETCHER,
Engineer and Manager.

Gas-Works, Leigh, Lancs.,
May 23, 1891.

**COUNTY BOROUGH OF STOCKPORT.**
(GAS DEPARTMENT.)

**THE Gas Committee invite Tenders** for the supply of CANNEL and COAL, averaging about 43,000 tons per annum, for One, Two, or Three years, commencing on the 1st of July next ensuing.

The Cannel and Coal offered must be screened, free from Bats, Bind, Refuse, or Dirt.

Forms of tender and full particulars as to quantities, mode of delivery, &c., can be obtained on application to the Engineer, Mr. S. Meunier, Millgate Gas-Works.

Tenders, stating price per ton, delivered in the Portwood Drops or Railway Station, Stockport, endorsed "Cannel, Coal, &c.," must be sent in, addressed to the Chairman of the Gas Committee, on or before the 11th day of June next.

No form of tender but that issued by the Committee will be considered.

The Committee do not bind themselves to accept the lowest or any tender.

WALTER HYDE,
Town Clerk.

Stockport, May 19, 1891.

AMMONIACAL LIQUOR AND SURPLUS TAR.

**THE Directors of the Barnsley Gas** Company are desirous of receiving TENDERS for the purchase of the whole of the AMMONIACAL LIQUOR, and for the surplus COAL TAR, produced at their Works at Pontefract Road and Old Mill, for a period of One, Two, or Three years, as may be agreed upon, commencing from July 1 next.

Probable quantity, and any other particulars, may be had on application to the undersigned.

Separate tenders, sealed, and endorsed "Tender for Ammoniacal Liquor" or "Surplus Coal Tar," as the case may be, addressed to the Chairman, to be sent to me on or before Tuesday, the 16th day of June, 1891.

The Directors do not bind themselves to accept the highest or any other tender.

By order,
JOHN HUTCHINSON, Manager.

Gas Office, Barnsley, May 21, 1891.

BOROUGH OF MACCLESFIELD.

**THE Gas Committee are prepared to** receive TENDERS for the supply of the undermentioned MATERIALS required during a period of Twelve months, commencing the 1st of July, 1891, viz.—

1. Wrought-Iron Lap-welded Steam Tubes and Fittings.
2. The best hand-picked Buxton Lime, delivered fresh at Macclesfield, free from Dirt and Ashes, in such quantities as may be ordered.
3. Cast-Iron Mains and Irregulars.

Forms of tender, &c., may be obtained on application to the Manager, Gas-Works.

Sealed Tenders, properly endorsed, to be addressed to the Chairman, Gas Committee, Town Hall, Macclesfield, and to be sent in not later than Saturday, the 6th of June, 1891.

The Committee do not pledge themselves to accept the lowest or any tender.

(Signed) W. FREDK. TAYLOR,
Town Clerk.

May 12, 1891.

TENDERS FOR COAL.

COMMERCIAL GAS COMPANY.

**THE Directors are prepared to receive** TENDERS for the supply of 140,000 tons of clean, dry, unscreened, fresh-wrought GAS COALS, delivered f.o.b. to the Company's Steamers at any suitable port, during the year ending the 31st of July, 1892.

The deliveries to be in equal monthly quantities throughout the year.

Payment in Cash fortnightly.

Particulars and forms of contract may be obtained from the Engineer, Mr. H. E. Jones.

The Directors do not bind themselves to accept the lowest or any tender.

Tenders, sealed, and endorsed "Tender for Coals," to be addressed to the Chairman of the Coal Committee, and delivered to the Company's Offices not later than the 11th of June next.

Commercial Gas-Works, Stepney, E.,
May 20, 1891.

TAR AND AMMONIA WATER.

**THE Directors of the Loughborough** Gas Company are prepared to receive TENDERS for the surplus TAR and AMMONIA WATER to be produced at their Works for One year, from the 30th day of June, 1891.

The estimated quantity will be about 350 tons of Tar, and 900 tons of Ammonia Water.

The Tar and Liquor to be delivered into the Contractor's boats at the Wharf on the Derby Road, Loughborough.

The strength of the Liquor to be tested by Twaddell's Hydrometer (temperature 60°), and the tender to state the price per ton of 4° up to 8°.

The boats for the removal of the Tar and Ammonia Water to be sent at such times as may be required.

Payments on the 10th of the following month.

Further information may be obtained on application to the undersigned, to whom tenders, in accordance with this advertisement, must be sent not later than the 4th of June next.

The Directors do not bind themselves to accept the highest or any tender.

J. B. BALL, C.E.,
Manager.

Loughborough, May 21, 1891.

**THE Hindley Local Board are prepared** to receive TENDERS for the purchase of the TAR and AMMONIACAL LIQUOR produced at their Gas-Works during the ensuing Twelve Months.

Full particulars, with form of tender, can be obtained on application to Mr. Wm. Dickinson, Gas and Water Manager.

Sealed tenders, endorsed "Tender for Tar, &c.," to be lodged with the undersigned not later than Monday, June 15, 1891.

By order,
STEPHEN HOLT,
Clerk to the Local Board.

Offices: Cross Street, Hindley,
May 22, 1891.

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TENDERS FOR GAS COAL.

**THE Directors of the Cheltenham Gas-**light and Coke Company are prepared to receive TENDERS for a supply of COAL, to be delivered between the 1st of August, 1891, and the 31st of July, 1892.

Particulars may be obtained from the undersigned, to whom tenders, endorsed "Tender for Coal," must be delivered on or before Tuesday, the 16th of June next.

The Directors do not bind themselves to accept the lowest or any tender.

R. O. PATERSON,
Engineer.

Gas-Works, Cheltenham,
May 23, 1891.

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COUNTY BOROUGH OF WIGAN.

TO COLLIERY PROPRIETORS.

**THE Gas Committee invite Tenders for** the supply of COAL and CANNEL for One, Two, or Three years.

Particulars and form of tender can be obtained from the undersigned.

The lowest tender not necessarily accepted.

Tenders, sealed, and endorsed "Coal and Cannel," to be delivered to Arthur Smith, Esq., Town Clerk, on or before Monday, the 15th prox.

JOS. TIMMINS,
Engineer, &c.

Borough Gas-Works, Wigan,
May 22, 1891.

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CRAYS GAS COMPANY.

SUPPLY OF COAL.

**THE Directors of the above Company are** prepared to receive TENDERS for the supply of about 5000 tons of GAS COAL, to be delivered between the 1st of July, 1891, and the 30th of June, 1893, in such quantities as shall from time to time be directed.

The Directors do not bind themselves to accept the lowest or any tender.

Tenders, stating price, to be addressed to the undersigned, and marked "Tender for Coal," so as to arrive not later than Tuesday, June 2, 1891.

W. B. MIMMACK,
Secretary.

Offices: The Gas-Works,
St. Mary Cray, Kent.

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WOLVERHAMPTON GAS COMPANY.

TO TAR CONTRACTORS.

**THE Directors of the Wolverhampton** Gas Company are prepared to receive TENDERS for the surplus TAR produced at their Works, for One, Two, or Three years, commencing the 1st of July next.

Yearly quantity, about 2300 tons.

Further information can be obtained from the Manager, Mr. J. Annan, Gas Office, Wolverhampton.

Tenders, sealed, and endorsed "Tender for Tar," addressed to the Chairman, to be delivered on or before Tuesday, June 9.

The Directors do not bind themselves to accept the highest or any tender.

ALBERT JONES,
Secretary.

Gas Offices, Wolverhampton,
May 20, 1891.

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TENDERS FOR GAS COAL.

**THE Llandudno Improvement Com-**missioners invite TENDERS for the supply of not less than 2000 tons of COAL capable of producing a minimum of 10,000 cubic feet of 17-candle Gas per ton, to be delivered, carriage paid, between the 1st of July, 1891, and the 30th of June, 1892, at the Llandudno Station of the London and North-Western Railway, in such quantities and at such periods as may be ordered from time to time.

Tenders, endorsed "Tender for Coal," to be sent to the undersigned, not later than Monday, the 8th of June next.

The Commissioners do not bind themselves to accept the lowest or any tender.

A. CONOLLY,
Clerk to the Commissioners.

May 23, 1891.

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SEVENOAKS GAS COMPANY.

TO COLLIERY PROPRIETORS AND AGENTS.

**THE Directors of the Sevenoaks Gas** Company are desirous of receiving TENDERS for the supply of 5000 tons of GAS COAL, to be delivered during Nine months from June, 1891, to March, 1892, at the Bat and Ball Station, L.C. & D. Railway, Sevenoaks.

The Districts preferred are those of Durham, Newcastle, and Yorkshire; and two-thirds of the quantity will have to be delivered by Dec. 31, 1891, and the remainder by the beginning of March, 1892.

The Directors reserve to themselves the right of dividing the contract among two or more firms, and are not bound to accept the lowest or any tender.

Forms of tender may be obtained on application to the undersigned; and the tenders themselves must reach the Company's Office not later than Wednesday, the 10th of June next, endorsed "Tender for Gas Coal," and addressed to the Chairman, William Hughes, Esq., 88, High Street, Sevenoaks.

By order,
HENRY HOW, Secretary.

Gas Office, Sevenoaks,
May 23, 1891.

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THE INCORPORATED

# Gas Institute.

THE TWENTY-EIGHTH

## ANNUAL GENERAL MEETING

OF THE MEMBERS

WILL BE HELD ON

*Tuesday, Wednesday, and Thursday,*

the 9th, 10th, and 11th of June, 1891,

AT THE

## COUNTY HALL, CARLISLE.

**J. HEPWORTH, Esq., M. Inst. C.E.,**

President, will occupy the Chair.

### LIST OF
### Papers and Communications
TO BE SUBMITTED TO THE MEETING.

*The order in which the Papers are to be read will be determined by the Council prior to the Meeting, so as to suit the general convenience.*

"On Some Bye-Products." By W. R. CHESTER, of Nottingham.
"On Competition with the Electric Light." By A. J. EDWARDS, of Taunton.
"On the Raising of a Retort-House Roof." By C. S. ELLERY, of Bath.
"On the Effects of Specific Hydrocarbons on the Lighting Value of Combustible Gas." By Professor W. FOSTER, of London.
"On the Enrichment of Coal Gas by the Various Processes other than Cannel." By Professor VIVIAN B. LEWES, of London.
"On Coal Storeage." By JAMES M'GILCHRIST, of Dumbarton.
"Gas Workers' Strikes; with Suggestions for their Prevention." By CHARLES NICKSON, of Manchester.
"On the Disposal of Sulphate of Ammonia Locally: Experience in Jersey." By T. N. RITSON, of Jersey.
"On the Effects of Wind Pressure on Retort-House Roofs and Gasholders." By A. T. WALMISLEY, of London.
"On the Diaphragm or Measuring Chamber of Dry Gas-Meters." By W. J. WARNER, of South Shields.

## Order of Proceedings.

### TUESDAY, 9th JUNE.

Official Reception by the Mayor and Corporation at the County Hall at 11 a.m.
Confirmation of Minutes of last Annual General Meeting and of the Statutory Meeting.
Appointment of Scrutineers to examine the balloting lists for the election of Officers, New Members, &c.
Presentation of Annual Report of Council.
Presentation of Statement of Accounts.
Address by the President.
Presentation of Awards.
Adjournment for Luncheon.
**Reading and Discussion of Papers and Communications.**
(The Annual General Meeting of Donors and Subscribers to the Benevolent Fund will take place at the close of the sitting at 5 o'clock p.m.)
[EVENING.—A Smoking Concert, given by the North of England Gas Managers' Association, will be held at the County Hall, commencing at 8.30 p.m. Members admitted on production of invitation card.]

### WEDNESDAY, 10th JUNE.

The Chair will be taken at 10 a.m.
**Reading and Discussion of Papers and Communications** continued.
Adjournment for Luncheon.
**Reading and Discussion of Papers and Communications** continued.
The sitting will close at 4 p.m., to give members the opportunity of visiting
The Engineering Works of Messrs. Cowans, Sheldon, & Co., Limited;
The Market Hall (where the chief features of the Roof will be described by the designer, Mr. A. T. Walmisley, M. Inst. C.E.);
And the following public works:—
The Gas-Works; the Water-Works; and the Public Baths.
On application at the Secretary's Office, at the County Hall, each member will be supplied on production of his card of Membership with a Guide Book describing the Cathedral, Castle, and other places of interest in Carlisle.
EVENING.—A Reception will be given in the County Hall by the Right Worshipful the Mayor of Carlisle (Mr. Alderman Benjamin Scott, J.P.), to commence at 8 p.m., and to be followed by a short dance (from 10 o'clock till 12). Music by Mr. Felix Burns' Band. Invitations have already been sent out to all Members who have intimated their intention to be present; but should any member, not having received an invitation, desire to attend, he is requested to communicate with the Secretary at once (giving full name and address, and also the names of any members of family or friends by whom he will be accompanied). Evening dress preferred.

### THURSDAY, 11th JUNE.

The Chair will be taken at 10 a.m.
**Reading and Discussion of Papers and Communications continued.**
Adjournment for Luncheon.
Report of the Scrutineers.
Applications for Transference.
Nomination by the Council of Mr. James Paterson (Past-President), of Warrington, for election as an Honorary Member.
Place of next meeting.
Votes of thanks.
[By the kind permission of the Right Honourable the Earl of Carlisle, a visit will be made to Naworth Castle, by special train leaving Carlisle Station at 5 p.m. Tickets (price 1s. each) should be obtained at the Secretary's Office, County Hall, on the previous day. Mr. C. J. Ferguson, F.S.A., has kindly consented to describe this interesting Border Castle. Light refreshments will be provided at Naworth by the President. Should time permit, a visit may also be made to Lanercost Priory, about 1½ miles distant. The return train will leave Naworth at 8.30 p.m.]

### FRIDAY, 12th JUNE.

Excursion to Keswick. A special train will leave Carlisle at 10 o'clock a.m. for Keswick, *viâ* Cockermouth, reaching Keswick about 11.55. Luncheon at 12.15 at the Keswick Hotel. Brakes will leave the hotel at 1.15, for a drive around Lake Derwentwater and through Borrowdale to Rosthwaite, passing Lodore Falls and the Bowder Stone, and returning to Keswick, *viâ* Grange and Portinscale, about 5.15 p.m., when tea will be provided at the hotel. The return train will leave Keswick at 6.45 p.m., Penrith at 7.35, and is timed to arrive at Carlisle at 8.5 p.m.—Tickets, to include railway fare, luncheon (wines, &c., not included), brake journey, and tea, 10s. 6d. each. In order to make adequate provision, it is absolutely necessary that members should obtain their tickets (at the Secretary's Office, County Hall) not later than Wednesday, 10th June.

**Société Technique de l'Industrie du Gaz en France.**—M. Salanson, the President of the above Society, has kindly invited Members of The Incorporated Gas Institute to attend the forthcoming Meeting of the Société Technique, in Paris, on the 16th, 17th, and 18th of June. Those Members who wish to attend are requested to communicate with the Secretary as soon as possible.

**Railway Facilities.**—As Carlisle is a town in connection with which many Railway Companies issue Tourist Tickets, Members intending to be present at the Meeting are advised to make enquiries at their respective Railway Stations with respect to facilities of this nature.

Members residing during the week of the Meeting at places near Carlisle are informed that during that week the Caledonian Railway, the London and North-Western, Maryport and Carlisle, Midland, North British, and North-Eastern Railway Companies will issue Return Tickets at Single Fares from Carlisle to places not more than 50 miles distant, upon production, at the Booking Office, of Cards of Membership.

**Secretary's Office.**—The County Hall, Carlisle, where all communications for the Secretary during the time of Meeting should accordingly be addressed.

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## The Incorporated Gas Institute.

### BENEVOLENT FUND.

The Annual General Meeting of the Donors and Subscribers to the Benevolent Fund will be held on Tuesday, the 9th of June, at 5 o'clock p.m.

Presentation of Report and Accounts.
General Business.

W. H. HARVEY, Secretary.

*3, Victoria Street, Westminster, S.W.,*
*May 25, 1891.*

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TO CONTRACTORS.

TENDERS FOR LAYING GAS-MAINS.

**THE Directors of the Sunderland Gas** Company are prepared to receive TENDERS for laying and jointing complete about 1½ miles of 24-inch and 18-inch GAS-MAINS.

Specification and form of tender can be had on application at the Company's Offices, Fawcett Street, Sunderland; and Tenders, endorsed "Tender for Laying Gas-Mains," must be delivered before Ten o'clock on the morning of Wednesday, June 3, 1891.

JOHN H. COX, Secretary.

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TO TAR DISTILLERS AND OTHERS.

**THE Directors of the Ossett Gas Com-**pany are prepared to receive TENDERS for the purchase of the AMMONIACAL LIQUOR and Surplus TAR produced at their Works during the Twelve months ending the 30th of June, 1892.

The Liquor to be quoted for, both by Twaddel's and Wills's Tests.

Tenders to be sent in not later than Wednesday, the 3rd of June next.

By order,
JAS. CASTLE, Secretary.

Ossett, May 21, 1891.

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ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

**THE Directors of the above Company** are prepared to receive TENDERS for a supply of Best Screened NEWCASTLE, LANCASHIRE, and DERBYSHIRE GAS COALS, to commence next October, for a period of One, Two, or Three Years—the annual quantity being about 100,000 tons—to be delivered monthly in accordance with a specification to be had on application to the Company.

About 90,000 tons are to be delivered annually alongside the Company's Stores, Sir John Rogerson's Quay, Dublin, and 10,000 tons on the Wharf, Dunleary Harbour, Kingstown, Co. Dublin.

Parties tendering can do so for the whole quantity or for quantities from 20,000 tons and upwards.

The Coals must be fresh, of the best quality, properly cleaned, free from dust, stones, pyrites, and all other impurities.

Tenders must state the name and locality of the pit or pits and the particular seam from which it is proposed to supply the Coals.

Tenders to quote price f.o.b. and *ex* ship Dublin and Kingstown, including cost, freight, and insurance.

The Contractors will be bound to supply the coal strictly in accordance with an analysis, which must accompany each tender.

Specifications for monthly deliveries, conditions of discharging, and all other information can be had on application to the Company's Offices.

The Directors do not bind themselves to accept the lowest or any tender.

Sealed tenders, directed to the Secretary, are to be lodged in the Company's Offices, D'Olier Street, on or before the 9th of June, endorsed "Tender for Coal."

W. F. COTTON,
Secretary and Manager.

Gas Offices, D'Olier Street,
May 13, 1891.

TO RETORT SETTERS AND GAS PLANT MAKERS.

**THE Gas Committee of the Cockermouth** Local Board invite TENDERS for the BUILDING of a RETORT STACK to contain twenty-four Retorts.

Also TENDERS for the supply and delivery of HYDRAULIC MAIN, and other IRONWORK for above.

Plans and specifications may be seen at the Gas-Works; and further information obtained from the undersigned.

Tenders, endorsed "Retort-Setting" or "Ironwork," to be sent in not later than Thursday, the 4th of June next.

ER. W. SMITH,
Gas Manager.

May, 1891.

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GUILDFORD GASLIGHT AND COKE COMPANY

TO TAR AND LIQUOR DISTILLERS.

**THE Directors of the Guildford Gaslight** and Coke Company are prepared to receive TENDERS for their surplus TAR and LIQUOR at their Works for the year ending June 30, 1892.

Probable quantity, 80,000 gallons of Tar, and 175,000 gallons of Liquor.

Tenders to state price for Tar per cask of 40 gallons, and for Liquor to state price per cask of 40 gallons of 5° and upwards.

Tenders, properly endorsed, and addressed to the Chairman of Directors, Gas Company, Guildford, must be delivered on or before Wednesday, June 3, 1891.

Any further required information on application to Mr. Longworth, Gas Offices, Guildford, Surrey.

Gas Offices, Guildford,
May 25, 1891.

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LEEK IMPROVEMENT ACT, 1855.

TO TAR DISTILLERS AND OTHERS.

**TENDERS are invited for the purchase** of the surplus GAS TAR produced at the Leek Gas-Works for One, Two, or Three years, from the 1st of July, 1891, at per ton of 2240 lbs. at such Works.

Endorsed tenders, addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leek, by Four o'clock in the afternoon of Monday, the 8th of June next.

Forms of tender and further particulars may be obtained from the undersigned.

The highest or any tender will not necessarily be accepted.

By order of the Commissioners,
C. HENSHAW,
Clerk.

Town Hall, Leek,
May 23, 1891.

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OAKENGATES AND ST. GEORGE'S GAS AND WATER COMPANY, LIMITED.

**THE Directors of this Company invite** TENDERS for the supply of 1400 tons of the best screened GAS COAL, delivered at the Great Western Railway Station, Oakengates, from July 1, 1891, to July 1, 1892, accompanied by name of Colliery and working analysis.

TENDERS for the supply of about 80 tons of LIME are invited for the same period.

Also for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at these Works for the same period. Quantity: About 60 tons of Tar, and 150 tons of Ammoniacal Liquor.

Tenders (of which the Directors do not bind themselves to accept the lowest or the highest) must be endorsed, and sent to the undersigned before June 16, 1891.

GEO. PARKER,
Manager.

Oakengates, Salop,
May 19, 1891.

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BROMLEY GAS CONSUMERS' COMPANY.

ADDITIONAL CAPITAL.

**NOTICE is hereby given, that under** the powers conferred by the Bromley Gas Act, 1879, the Directors are prepared to receive TENDERS for the purchase of 400 ORDINARY SHARES, of the nominal value of £10 each, in lots not being less than Five of such Shares, or a multiple thereof.

The Shares tendered for will be entitled to a standard Dividend not exceeding 7 per cent., subject to variation in accordance with a Sliding Scale as in the said Act is provided.

Conditions of sale and forms of tender may be obtained upon application to the Secretary of the Company at the Works, Bromley, Kent; or of Messrs. Latter and Willett, Market Square, Bromley, Kent.

Tenders must be sent in not later than Saturday, the 20th day of June, 1891, at Three o'clock, p.m., addressed to the undersigned, at the Company's Works, Bromley, Kent.

HENRY W. AMOS,
Secretary.

Bromley, Kent, May 21, 1891.

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LEA BRIDGE DISTRICT GAS COMPANY.

BY ORDER OF THE DIRECTORS.

Sale of 1000 £10 shares, part of the further additional Share Capital authorized by the Lea Bridge Gas Act, 1878, ranking for a Dividend of 7 per cent. per annum, subject to usual Sliding Scale Clauses.

**MR. ALFRED RICHARDS will Sell the** above by AUCTION at the Mart, Tokenhouse Yard, E.C., on Monday, June 22, 1891, at One for Two o'clock precisely in lots, instead of May 28, as previously advertised.

Particulars may be obtained of RICHARD SANDELL, Esq., at the Company's Offices, 8, Jeffreys' Square, St. Mary Axe, E.C., and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

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TO INVESTORS AND CAPITALISTS.

KETTERING WATER-WORKS COMPANY.

ISSUE OF NEW ORDINARY SHARES AND FIRST MORTGAGE DEBENTURES.

**MESSRS. J. ROBINSON AND SON** are instructed by the Directors to offer FOR SALE by Public Auction, in Lots, at the Corn Exchange, Kettering, on Friday, June 5, 1891, at Half-past Five for Six o'clock in the evening precisely, pursuant to the provisions of the Kettering Water-Works Act, 1889 (under which all new Shares are to be offered for sale by auction or by tender before being offered to the existing shareholders), 600 NEW ORDINARY SHARES of £10 each in the above Company, part of an additional capital authorized to be raised for the purposes of New Works now in course of construction, and which have been rendered necessary by the constantly increasing demand for the Company's Water, consequent upon the extraordinarily rapid growth of the population and industries of the town.

The Directors also invite APPLICATIONS for £5500 FIRST MORTGAGE DEBENTURES IN BONDS of £100 each, bearing interest at 4 per cent. per annum and redeemable on the 24th of June, 1898.

For information as to the Company's position, and the dividends lately paid on its present capital, with printed particulars and conditions of the present issues, and forms of applications for debentures, apply to the AUCTIONEERS; to Messrs. G. & H. LAMB AND STRINGER, Solicitors; or to Mr. T. A. SIMPSON, Secretary and Manager, all of KETTERING.

---

*Price 2s. per dozen, or 10s. 6d. per 100, post free.*

**CONSPIRACY and Protection of Property Act.** It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

*** *The Act extends to Scotland and Ireland.*

---

*RE* A. HOWES, ESQ., DECEASED, T. C. HUDSON, ESQ., DECEASED, AND OTHERS.

Important SALE of GAS and WATER Shares in the
Crystal Palace District Gas Company,
Romford Gas Company,
Enfield Gas Company,
South Essex Water Company,
Grays Gas Company,
Colney Hatch Gas Company,
Harrow District Gas Company,
South-West Suburban Water Company,
Tottenham and Edmonton Gas Company,
Uxbridge Gas Company; also in the
Equitable Insurance Company, and
The Patent Victoria Stone Company.

**MR. ALFRED RICHARDS will Sell** the above BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Monday, June 1, 1891, at Two o'clock precisely, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

---

**LEAFLETS for Distribution by Gas** Companies and Corporation Gas Committees:—

OIL OR GAS FOR LIGHTING OUR HOMES? Price (delivered free) 5s. per 100; £2 per 1000. Larger quantities by agreement. Specimen copy, by post, 1½d.

THE COMPOSITION AND USE OF GAS LIME IN AGRICULTURE. By (the late) Dr. A. VOELCKER, Professor of Chemistry to the Royal Agricultural Society of England. Price 5s. per 100, post free.

THE VALUE OF SULPHATE OF AMMONIA AS A MANURE. By F. J. LLOYD, F.C.S., Consulting Chemist to the British Dairy Farmers Association, Lecturer on Agriculture at King's College, &c. Price 5s. per 100, post free.

THE USE OF SULPHATE OF AMMONIA AS A MANURE. By WILLIAM ARNOLD, Chairman of the Tamworth Gas Company. Price 2s. 6d. per 100, post free.

Published by WALTER KING, 11, Bolt Court, Fleet Street, LONDON, E.C.

---

**MR. W. H. BENNETT** having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their Inventions may be secured for Twelve months; or LETTERS PATENT which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

Patents procured for Foreign Countries.

Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street WESTMINSTER.

---

**THOMAS ILLINGWORTH,**
**NORTH DEAN CHEMICAL WORKS,**
Near HALIFAX,
*MANUFACTURER OF SULPHURIC ACID*
OF EXTRA QUALITY FOR MAKING
**WHITE SULPHATE OF AMMONIA.**

TAR, LIQUOR, AND SPENT OXIDE
Purchased for Cash against Delivery

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## GASHOLDERS; PURIFIERS; PURIFYING MACHINES;

$CO_2$ AND TAR-EXTRACTING WASHERS; SCRUBBERS;

**SULPHATE & SULPHUR PLANT;**
**RETORT MOUTHPIECES; CONDENSERS;**

LIFTING APPARATUS; CENTRE AND FOUR-WAY VALVES;
SLIDE VALVES; TAR BURNERS; &C., &C.

**WOOD SIEVES.**

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PATENTS FOR INVENTIONS,
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SEARCHES made *re* novelty, and opinions given on all matters connected with above. *Full particulars on application to*

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*Special experience in Gas and Ammonia Plant.*

For FIRE-BRICKS, the most durable for GAS-FURNACES,
ADDRESS
JAMES WHITE & Co., Limited,
ALBERT WORKS, WIDNES.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1½ to 48 inches in diameter; and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

ESTABLISHED 1872.

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GLASGOW.
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*GAS EXAMINER, AND ASSAYER.*
FEES MODERATE.

Lanemark Coal Co.,
LIMITED.
LANEMARK CANNEL
AND GAS COALS.

*Quotations and Analysis on application to*

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NEW CUMNOCK, N.B.

Shipping Ports: All the principal Scotch Ports.

HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)

PRESENT production nearly 3000 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16½ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves 69 per cent. of excellent Coke. During the year 1890, the London Gas Companies carbonized about 400,000 tons of HOLMSIDE COALS. They are used by The Gaslight and Coke Company, the South Metropolitan Gas Company, the Woolwich (Government) Gas-Works, the Newcastle and Gateshead Gas Company, the European Gas Company, L'Union des Gaz, and by many other Gas Companies both at Home and Abroad.

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HOLMSIDE AND SOUTH MOOR OFFICES,
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COKE BREAKERS,
PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT.)

*New Design, with two Cutting Rollers, making less Breeze than their old pattern.*

GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.

HEBBURN MAIN GAS COALS.

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| Produce of Gas per ton | 10,500 feet. |
| „ Coke „ | 13½ cwt. |
| Illuminating Power | 16 candles. |

*For Prices, f. o. b. Ship or delivered, apply to*

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THOMAS LIGHTING Co.,
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Manufacturers of the "Thomas" Patent Lamps for general lighting, also for Public Buildings, Institutions, &c., and for outside purposes.

The best Regenerative Lamp in the Market.

*Special quotations to Gas Companies.*

THE SILICA FIRE-BRICK
COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS,
BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

TROTTER, HAINES, & DORBETT,
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FIRE-CLAY & BRICK WORKS,
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Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

SOOTHILL WOOD CANNEL.

Yield of Gas per Ton, over 12,000 Cubic Feet.
Illuminating Power - - - - - 26 Candles.
Coke per Ton, - - - - - - - 57 per cent. of a quality almost equal to that made from the best Coking Coal.

*For Analysis and Price, apply to*

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SOOTHILL WOOD COLLIERY,
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AND SONS, LIMITED,
Sheaf & Spring Works,
SHEFFIELD,
*MANUFACTURERS OF*
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Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

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BOGHEAD
CANNEL.

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| Yield of Gas per ton | 13,155 cub. ft. |
| Illuminating Power | 38·22 candles |
| Coke per ton | 1,301·88 lbs. |

EAST PONTOP
GAS COAL.

| | |
|---|---|
| Yield of Gas per ton | 10,500 cub. ft. |
| Illuminating Power | 16·3 candles. |
| Coke | 70 per cent. |

*For Prices and complete Analysis, apply to*

YOUNG, DANCE, & CO.,
COAL OWNERS, NEWCASTLE-ON-TYNE.
Or E. FOSTER & CO., 21, John St., Adelphi, LONDON, W.C.

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Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

*Prices and Analysis on application.*

MIRFIELD (GAS-COAL) COLLIERY COMPY.

MIRFIELD, NORMANTON.

NEWBATTLE CANNEL.

QUOTATIONS ON APPLICATION TO

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LIMITED,

NEWBATTLE COLLIERIES,

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CAST-IRON PIPES

FOR GAS AND WATER.

Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.

VALVES

FOR GAS, WATER, AND STEAM.

TELEGRAMS: "PIPES GLASGOW."

WM. MACLEOD & CO.,

56, ROBERTSON STREET, GLASGOW

## THE WENHAM COMPANY, LIMITED,

*v.*

## THE CHAMPION GAS-LAMP COMPANY, LIMITED.

**WHEREAS** the above-mentioned action for Infringement of Letters Patent granted to Frank William Clark, dated 1st July, 1881, No. 2869 (of which Letters Patent the Wenham Company, Limited, are the Assignees), was tried before Mr. Justice Vaughan Williams, on the 7th, 8th, and 9th day of May, 1891, and on the 13th day of May, 1891. Judgment in the said Action was given the Plaintiffs, the Wenham Company, Limited, and a perpetual Injunction was granted, restraining the Defendants from infringing the said Patent. An inquiry was directed as to the damages suffered by the Wenham Company Limited; and the Defendants were ordered to deliver up certain lamps made in infringement of the said Patent, and to pay to the Plaintiffs the cost of the said Action.

NOTICE IS HEREBY GIVEN, that legal proceedings will forthwith be taken by the Wenham Company, Limited, against all persons who make or sell Lamps constructed according to the invention comprised in the above-mentioned Patent or who otherwise infringe the same Patent.

J. H. JOHNSON, SON, & ELLIS,
47, LINCOLN'S INN FIELDS, LONDON, W.
Solicitors for the Wenham Company, Limited.

FIRE BRICKS,
LUMPS, TILES,
BLOCKS, &c.

Special Bricks for Intense Heats.

GAS RETORTS.

CASTINGS AND EVERY REQUISITE FOR GAS-WORKS.

MOBBERLEY & PERRY,
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☛ Retort Setters sent to any part of the Kingdom.

RETORT SETTINGS IMPROVED

BY ADOPTING

THE "NUGENT" & "ROBUS" SETTINGS.

ECONOMY WITH DURABILITY GUARANTEED.

HUNDREDS OF SETTINGS WORKING EMINENTLY SATISFACTORY.

*Estimates and Particulars for every Description of Retort Extensions and other Work.*

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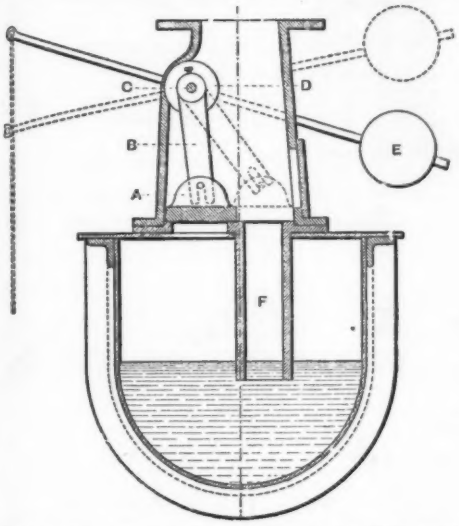
## WOOD SIEVES,

## LIFTING APPARATUS, &c.

**ELLAND, YORKSHIRE.**




## MEIKLEJOHN'S

PATENT

## IMPROVED SLIDE-VALVE ANTI-DIP

**Is perfectly reliable in action, and requires no attention.**
**Has all the advantages of the Dip and Anti-Dip combined.**
**Is cheap, and easily fixed to any form of main.**
**Will save more than their cost in one season's working.**

MR. THOS. NEWBIGGING'S REPORT.

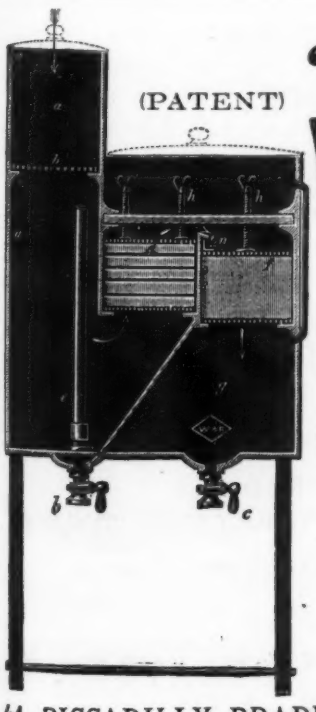
*5, Norfolk Street, Manchester, Dec.* 11, 1889.

SIR,—I have examined your Anti-Dip arrangement, and have seen it at work on the Retort-Benches at the Longwood Gas-Works, and the opinion which I have formed of its simplicity and certainty in working is distinctly favourable; so much so *that I consider it to be, without exception, the most efficient Appliance of the kind which has yet been introduced.* It can be applied to existing Benches with great ease, and at a minimum cost. So far as I am aware, it embodies a principle of action not previously applied in this direction.—Yours truly, THOS. NEWBIGGING.

Further particulars from the Sole Patentee and Manufacturer,

**NEILL MEIKLEJOHN,**
GAS ENGINEER,
LONGWOOD, HUDDERSFIELD.

∴ During the serious illness of Mr. Neill Meiklejohn, all communications as to the above should be addressed to C. Meiklejohn, Gas Engineer, Oldbury, near Birmingham.



THE

## "Diamond"

(PATENT)

## Waste Oil Filter

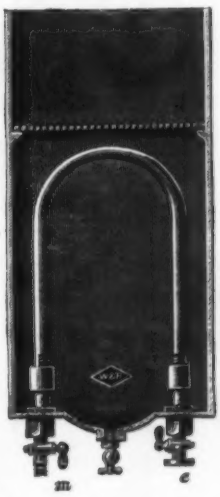
FOR

*Purifying Refuse Oil and Grease, in Engine-Rooms, Boiler-Houses, &c.*

**PAYS FOR ITSELF IN A VERY SHORT TIME.**

**Used by**

*Stafford Corporation Gas-Works; L.B. & S.C. Ry. Co., New Cross; Union Bank, Ltd., London; H.H. The Maharajah of Mysore; Plymouth Works; &c., &c.*




**Prices and Particulars on application to**

## WOODHOUSE & RAWSON

**UNITED, LIMITED,**

88, QUEEN VICTORIA STREET, LONDON, E.C.;
41, PICCADILLY, BRADFORD; & CORNBROOK TELEGRAPH WORKS, MANCHESTER.

## JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of

ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

# ALDWARKE MAIN GAS COAL

**Analysis: 12,600 feet of 19-candle gas per ton.**

**Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.**

*Telegrams: "ATLAS SHEFFIELD."*

# SAVILLE'S PATENT REGULATOR WASHER

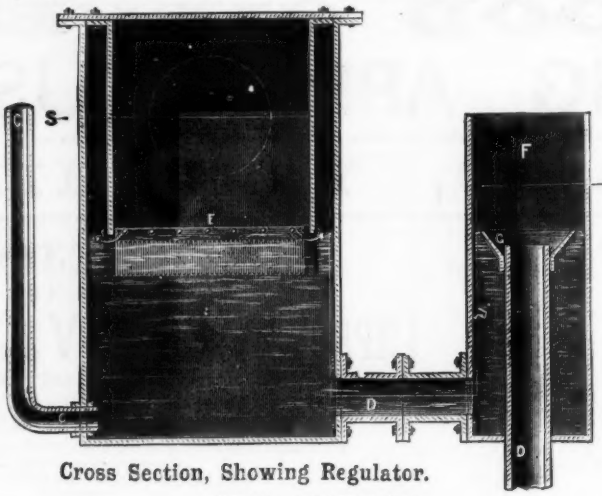
(As described in the JOURNAL OF GAS LIGHTING for Sept. 2, 1890.)

The only Washer without moving parts that can be fixed before an Exhauster.

No more Gas spoilt by over-running the Exhauster.

Perfectly Self-acting.

**Particulars and prices on application.**




Cross Section, Showing Regulator.

The only safe arrangement to work without Dip.

Less wear and tear on the Exhauster.

No moving parts.

Occupies small space.

**State maximum make of Gas per diem.**

*SOLE MAKERS:*

## W. C. HOLMES & CO.,

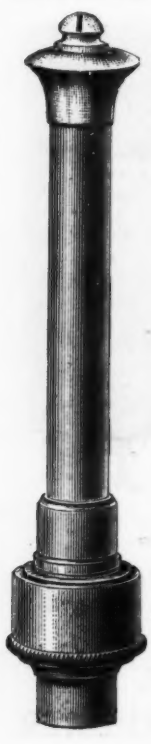
**WHITESTONE IRON-WORKS, HUDDERSFIELD.**

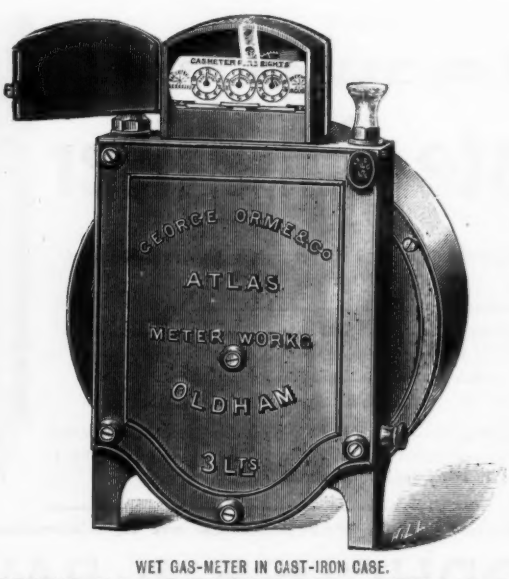
# GEORGE ORME & CO.,

## MANUFACTURERS OF IMPROVED WET AND DRY GAS-METERS,

**ATLAS METER WORKS, OLDHAM.**

Telegraphic Address: "ORME OLDHAM." Telephone No. 93, OLDHAM.






WET GAS-METER IN CAST-IRON CASE.

DRY GAS-METER IN STRONG TIN-PLATE CASE.

ORME'S GAS REGULATOR (BEHL'S PATENT) FOR STREET LAMPS,

AS ILLUSTRATION NO. 200.

**Adopted by the leading London and Provincial Gas Companies.** **More than 150,000 now in use.**

ORME'S PATENT SUSPENSION REGULATORS.

Prices and full particulars on application.

# MORRIS & CUTLER'S PATENT CONDENSER

## GIVES EASY CONTROL OVER TEMPERATURE OF GAS AT ALL SEASONS IN ANY CLIMATE.

**EQUALLY SUITABLE FOR LARGE OR SMALL WORKS.**

**IN USE AT THE PRINCIPAL GAS-WORKS AT HOME AND ABROAD INCLUDING THE FOLLOWING:—**

| ERECTED AT | Capacity per diem. Cubic Feet. | ERECTED AT | Capacity per diem. Cubic Feet. |
|---|---|---|---|
| ABINGDON .. .. .. .. | 250,000 | MANCHESTER .. .. .. | 3,300,000 |
| BEXHILL .. .. .. .. | 150,000 | MELBOURNE (Australia) .. .. | 2,000,000 |
| BARNET.. .. .. .. .. | 750,000 | Do. (2nd order) .. .. | 5,000,000 |
| BELGRANO (Argentine) .. .. | 700,000 | Do. (West) .. .. | 5,000,000 |
| BOURNEMOUTH .. .. .. | 1,000,000 | Do. (South) .. .. | 3,600,000 |
| Do. (2nd order) .. | 1,000,000 | NOTTINGHAM.. .. .. .. | 2,000,000 |
| BRISBANE (Australia) .. .. | 1,250,000 | READING .. .. .. .. | 500,000 |
| Do. (2nd order) .. .. | 1,250,000 | Do. (2nd order) .. .. | 2,000,000 |
| BUXTON .. .. .. .. | 250,000 | REDDITCH .. .. .. .. | 250,000 |
| BUENOS AIRES (Argentine) .. | 1,000,000 | RYDE .. .. .. .. .. | 500,000 |
| COVENTRY .. .. .. .. | 1,500,000 | RIDDINGS .. .. .. .. | 250,000 |
| CREWE (L. & N.W. Rly. Works) .. | 300,000 | ROCKHAMPTON (N.Z.) .. .. | 200,000 |
| Do. do. (2nd order) .. | 300,000 | RYDERS GREEN .. .. .. | 600,000 |
| CROYDON .. .. .. .. | 1,250,000 | SOUTHALL .. .. .. .. | 1,250,000 |
| FAVERSHAM .. .. .. .. | 250,000 | STOURBRIDGE .. .. .. | 600,000 |
| FISON & CO. .. .. .. .. | 50,000 | SYDNEY (Australia).. .. .. | 2,500,000 |
| GREENWICH .. .. .. .. | 1,000,000 | SUTTON (Surrey) .. .. .. | 500,000 |
| HASTINGS .. .. .. .. | 2,000,000 | VENTNOR .. .. .. .. | 200,000 |
| HORNSEY .. .. .. .. | 1,250,000 | WELLINGTON COLLEGE .. .. | 50,000 |
| HODDESDON .. .. .. .. | 200,000 | WINDSOR .. .. .. .. | 600,000 |
| JAMMAGE COLLIERY .. .. | 1,000,000 | WISBECH .. .. .. .. | 200,000 |
| JERSEY.. .. .. .. .. | 500,000 | WORTHING .. .. .. .. | 200,000 |
| LIVERPOOL .. .. .. .. | 2,000,000 | WINCHESTER .. .. .. | 400,000 |
| LUTON .. .. .. .. .. | 750,000 | WARE .. .. .. .. .. | 150,000 |
| MAIDENHEAD .. .. .. | 200,000 | YARMOUTH, &c., &c... .. .. | 1,000,000 |
| MAIDSTONE .. .. .. .. | 800,000 | | |

WORKS:
PROVIDENCE IRON-WORKS, MILLWALL, LONDON, E.
Telegrams: "CUTLER, MILLWALL, LONDON."
Telephone: 5059.

OFFICES:
16, GT. GEORGE STREET, WESTMINSTER, S.W.
Telegrams: "RETORTUS, LONDON."
Telephone: 3223.

A.B.C. CODE USED. 4th EDITION, 1883.

# "THE METEOR."

## NEW HIGH-POWER GAS-LAMP.

**Westphal's Patent.**

Gas Companies should hire these Lamps to their Consumers, and introduce them for Street Lighting as a rival to the Electric Light, as they do not get out of order, are most economical, and the Burner being a circular slit does not choke up.

*Particulars and Prices Free.*

**HENRY GREENE & SONS,**

SOLE CONSIGNEES FOR GREAT BRITAIN & COLONIES.

153 TO 155, CANNON STREET,
LONDON BRIDGE, E.C.

TELEGRAPHIC ADDRESS: "GAS LEEDS."

60, QUEEN VICTORIA STREET, E.C. LONDON OFFICE.

## CLAYTON, SON, & Co.

LIMITED,

LEEDS,

MAKE

# RETORT LIDS

OF ALL FORMS AND SHAPES IN IRON OR STEEL

BY SPECIAL HYDRAULIC MACHINERY.

PRICES ON APPLICATION.

# SPENT LIMES NO LONGER WASTE PRODUCTS.

## Under G. R. HISLOP'S PATENTS

All Spent Limes are most effectually, economically, and continuously recovered, and at from one-third to one-half the cost of New Lime. The results are a surprise to all who have inspected the process, and are entirely satisfactory to all now using it. Descriptive Pamphlet and Terms from Agents as under.

## REGENERATIVE SETTINGS OF RETORTS.

Hislop's Patent Producer and Patent Charging Appliances offer advantages which are unapproachable, while in every other detail his Settings are confidently recommended as being the most inexpensive and effective possible.

*Illustrated Pamphlet and Terms on application to J. E. FISHER, Stourbridge, Agent for England and Wales; to C. M. HAMILTON, Portland Place, Hamilton, Agent for Scotland and Ireland; and for all other Countries to the Patentee,*

Geo. R. HISLOP, Gas Engineer, PAISLEY, N.B.

# G. J. EVESON,

## GAS COAL AND CANNEL CONTRACTOR,

PATENTEE OF

## A SPECIAL COMPOUND

*FOR THE CURE OF STOPPED ASCENSION-PIPES,*

A couple of charges of which will clear a stopped pipe, and an occasional charge keeps them clean, and also increases the make per ton and the illuminating power.

PRICE AND PARTICULARS ON APPLICATION.

**Head Office: CORPORATION STREET, BIRMINGHAM.**

# ASHMORE, BENSON, PEASE, & CO., LTD., STOCKTON-ON-TEES.

TELEGRAMS "Gasholder"
MAKERS OF LARGEST GAS HOLDER IN THE WORLD
STOCKTON-ON-TEES
SIMPLE IN CONSTRUCTION EFFECTIVE IN RESULTS
ASHMORE BENSON PEASE & Co
SULPHATE PLANT
DAVIS PATENT
ECONOMICAL IN COST & SPACE
STILLS IN STOCK 2 3 & 4 FEET DIA.
MAKERS OF
ALL GAS PLANT &
Every kind of Constructional Ironwork
OIL GAS PLANT FOR WORKS VILLAGES & MANSIONS
PEASE'S Patent WIRE ROPE SYSTEM
for Guding Gasholders . Effecting a Saving of 25 per cent in Cost

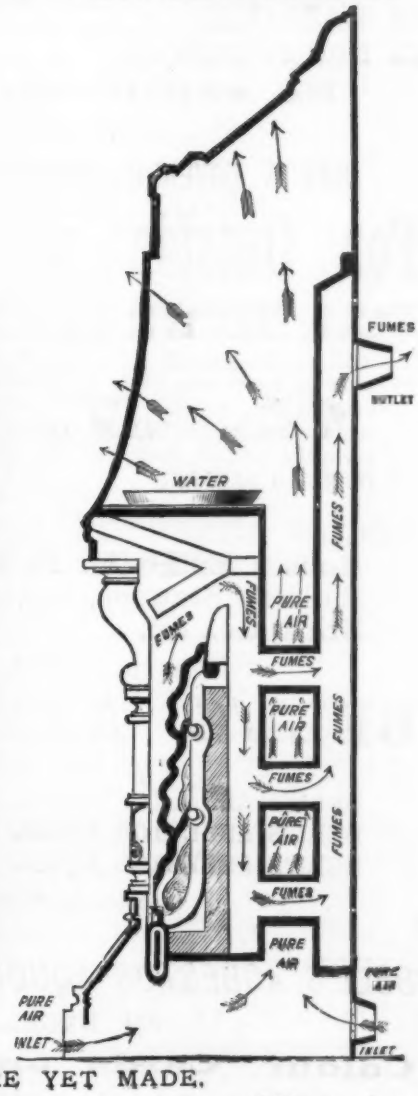
ONLY GOLD MEDAL Food and Cookery Exhibition, 1890.

# H. DARWIN & CO., LIMITED,

## GAS FIRE AND STOVE MANUFACTURERS.

# THE "DARWIN"

## CALORIC GAS-FIRE.




NEAREST APPROACH TO A COAL FIRE YET MADE.

*Elegant in Design.* **PATENT FIRE.** *Silent Jet.*

| PRICES. | No. 1. | No. 2. | No. 3. |
|---|---|---|---|
| Best black finished | £2 5 0 | £2 15 0 | £3 5 0 |
| Best Berlin black finish | 2 15 0 | 3 7 0 | 4 0 0 |
| Top Panels Electro Nickelled, Brassed, or Copper Bronzed | 2 15 0 | 3 7 0 | 4 0 0 |
| Top Panels and Sides do. | 3 3 0 | 3 15 0 | 4 8 0 |
| Stove all do. | 3 10 0 | 4 5 0 | 5 0 0 |

With Hand-Painted Tiles, 10s. to 20s. extra.

ST. ANDREW'S WORKS, 618 to 622, EGLINTON STREET, GLASGOW.

# BELL'S ASBESTOS AQUOL PAINT

## IS MADE READY FOR USE.

IS FIRE RESISTING.
IS WASHABLE.
IS NON-POISONOUS.
IS MANUFACTURED IN ALL USEFUL COLOURS.
IS IMPERVIOUS TO HEAT, COLD, OR WATER.
IS WITHOUT SMELL.

**No expensive Oil or Turpentine required.**

WILL NEVER BLISTER.

HAS A COVERING CAPACITY 40 PER CENT. GREATER THAN LEAD PAINTS.

## For Outside or Inside Work in any Climate.

**Bell's Asbestos Aquol Paint** is equally suitable for the finest decorative work as well as for general painting. It can be applied over or under any other paint, and, owing to its easy application, can be used with a large distemper brush; the SAVING THUS EFFECTED IN LABOUR BEING **50** PER CENT. OVER THAT OF LEAD PAINTS.

**Bell's Asbestos Aquol Paint** is susceptible of the most delicate treatment; and, owing to its perfect flatted surface, it brings up the varnish in a manner that no other paint can equal. ONE COAT OF VARNISH ON **Bell's Asbestos Aquol** IS EQUAL TO TWO COATS ON ORDINARY PAINT.

**BELL'S ASBESTOS AQUOL PAINT** is specially adapted for Private Houses, Exhibition Buildings, Ships, Churches, Asylums, School Boards, Railway Stations, and all work of Wood, Iron, Cement, Plaster, Stone, Brick, &c., &c.

*Those who Study Economy and Protection from Fire should use only*

## BELL'S ASBESTOS AQUOL PAINT.

**BELL'S ASBESTOS AQUOL PRIMING is made Ready for Use.**
**BELL'S ASBESTOS AQUOL PRIMING stops all suction of Wood, Cement, Plaster, &c.**
**BELL'S ASBESTOS AQUOL PRIMING should be applied to all New Work.**

**Suitable for Ceilings, Walls, and New Wood, and is very durable.**

*BELL'S ASBESTOS AQUOL KNOTTING, for Stopping Knots in New Work.*

**AN EXCELLENT CURE FOR DAMP WALLS.**

**Colour Cards and Price Lists on Application.**

Supplied in Casks of 5 to 7 cwt., and Iron Drums of 28, 56, and 112 lbs., Sample Tins of 7 and 14 lbs.

**Owing to its Covering Capacity, a SAVING IN FREIGHT of 40 per cent. is effected for a given surface.**

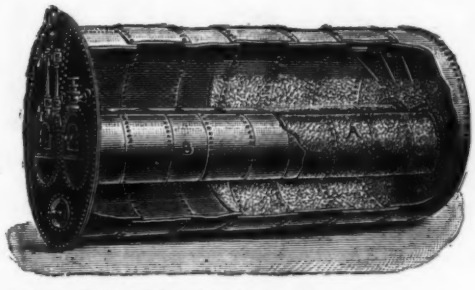
## BELL'S ASBESTOS COMPANY, LIMITED,

SOUTHWARK, LONDON, S.E.

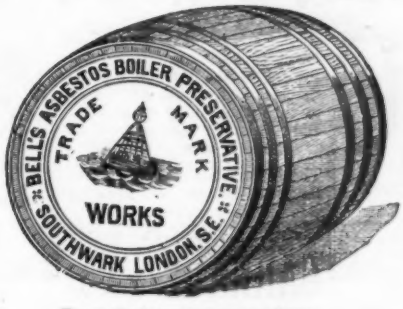
DEPOTS—MANCHESTER: Cable Street, Blackfriars. LIVERPOOL: 2, Strand Street, James Street. HULL: Humber Dock Basin. GLASGOW: 35, Robertson Street. DUBLIN: 2, St. Andrew Street. BERLIN, BARCELONA, and ANTWERP.
AGENTS—BIRMINGHAM BELL and Co., John Bright Street. BRISTOL: ROBERT STOTESBURY 114, Redcliff Street. CARDIFF: BELL and Co., West Bute Street.

# BELL'S ASBESTOS BOILER PRESERVATIVE

**Will remove Incrustation from Steam-Boilers of all kinds without chipping.**



A shows Boiler Plates when incrusted.
B shows Boiler Plates when cleaned by this Composition.



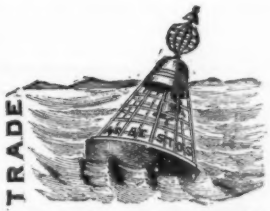

Every Cask is sent out as above.

The action of this **BOILER PRESERVATIVE,** by absorbing the free oxygen that is in the water, **entirely checks pitting and corrosion.** It also disintegrates incrustation so immediately as to prevent its adhering to the plates; and the deposit falls to the bottom in a loose powder, which is easily swept out. By keeping boilers clean, a **great economy of fuel is effected,** and the danger of the plates burning is entirely obviated; thus avoiding the great risks which are inseparable from scaled plates, lengthening the life of a boiler, and **covering its own cost a hundredfold.** Whenever possible it should be used through Feed Pump or Injector, which it will also keep clear from incrustation. The small quantity required to effect its purpose makes this the most economical, and more than repays the higher price we charge for a fluid which, in the case of many other makers, is useless.

**QUANTITY REQUIRED.** A quarter of a pint weekly per horse power indicated; where the water is very bad rather more, or one pint for every 700 gallons of water evaporated.

# BELL'S ASBESTOS CO., Ld.

**DEPÔTS.**
MANCHESTER: Cable St., Blackfriars.
LIVERPOOL: 2, Strand St., James St.
HULL: Humber Dock Basin.
GLASGOW: 35, Robertson Street.
DUBLIN, BERLIN.




**DEPÔTS.**
BARCELONA, and ANTWERP.
**AGENTS.**
BIRMINGHAM: BELL and Co., 7, John Bright Street.
BRISTOL: ROBERT STOTESBURY, 114, Redcliff Street.
CARDIFF: BELL and Co., West Bute St.

**SOUTHWARK,** BELL'S ASBESTOS. **LONDON, S.E.**

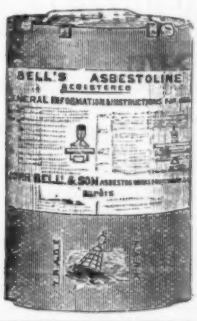
BELL'S ASBESTOS
## YARN AND SOAPSTONE PACKING
BEST LOCOMOTIVE PACKING made.

BELL'S
## COMPOUND HYDRAULIC PACKING
Is specially suited for
Hydraulic Machinery, Accumulators and Ammonia and all Pumps.

## BELL'S ASBESTOS LUBRICANT
Is unequalled
For Steam-Engines & Cylinders, Gas-Engines, and every class of machinery.

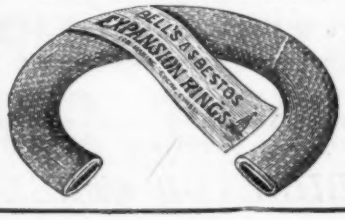
## BELL'S ASBESTOLINE
The reputation of this Lubricant is based on the experience of thousands of users, which places it far in advance of those who rely only on mere laboratory tests.

ASBESTOLINE IS THE CHEAPEST MOST EFFICIENT, CLEANEST MOST INODOROUS AND SAFEST LUBRICANT.

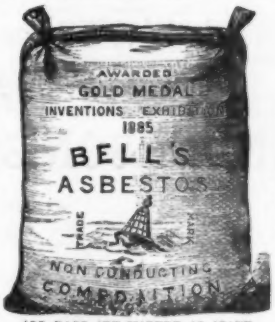



ASBESTOLINE HAS SAVED 90 PER CENT. OVER OIL.
Has been used for all purposes, AND BEATEN ALL OTHER LUBRICANTS IN ACTUAL WORK.

BELL'S ASBESTOS
## EXPANSION SHEETING
RINGS, AND TAPE.
Is the most efficient and reliable Material for Manhole, Mudhole, Steam-Pipe, and all other Joints.



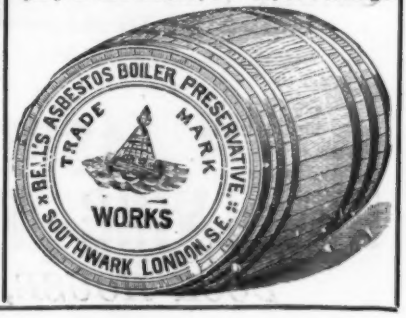

BELL'S ASBESTOS
## NON-CONDUCTING COMPOSITION.
Will reduce loss by radiation and save 40 per cent. of fuel.
Is superior to any other, and saves its cost in a few months.




Can be applied again after many years' service. Is sent out dry, in bags; therefore cheaper than others sent out wet.

ALL BAGS ARE MARKED AS ABOVE.

BELL'S ASBESTOS
## BOILER PRESERVATIVE
Will effectually keep Boilers clean, and remove any Incrustation, without injury to the Boiler, Plates, or Fittings.



CONVENIENCE, SAFETY, ECONOMY.

**CARNABY'S**

## Patent Safety Gas Apparatus,

(Main Tap Regulator)

fixed in any part of the house most convenient for use, gives immediate and full control of the Gas throughout the premises, enabling the user to turn the supply on and off, and regulate its admission to the meter as required.

The **Apparatus** combined with **Pressure-Gauge** or **Locking Appliance.**

Telegrams: "CARNABY LONDON"

**CARNABY & Co.**

13, BROAD STREET, BLOOMSBURY, LONDON.

**JONAS DRAKE & SON.**

—GAS— —ENGINEERS— —CONTRACTORS— —IRONFOUNDERS— —RETORT SETTERS— —ETC.—

Specialities in CARBONIZING PLANT. GENERATOR AND REGENERATOR FURNACES.

OVENDEN,

**HALIFAX** (YORKS.)

AUTOMATIC SYSTEM OF CHARGING AND DRAWING

# INCLINED GAS-RETORTS.

Gold Medal, Paris Exhibition, 1889.

By this process there is obtained—

1. A SAVING OF **70** PER CENT. IN THE CARBONIZING OF COAL.
2. AN AVERAGE SAVING OF **2s. 3d.** PER TON ON ALL COAL CARBONIZED.

Which represents a saving of **One Million Sterling** per Annum to Gas Companies in the United Kingdom alone.

This System is being largely adopted at several places on the Continent and in America, and at various Gas-Works in England—notably at the Works of The Gaslight and Coke Company, the South Metropolitan Gas Company, and the Brentford Gas Company.

For Illustrated Description, see Advt. p. 861.

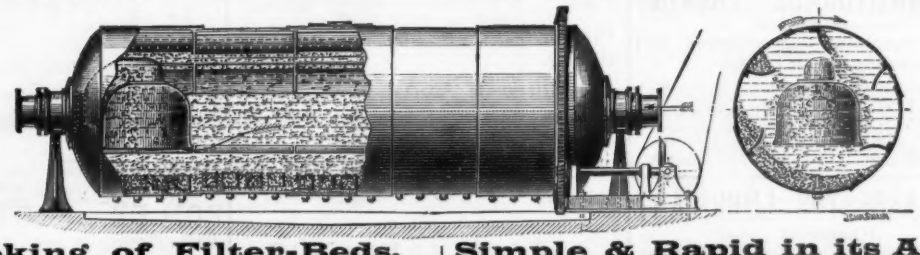
*THE PROCESS IS FULLY PATENTED, AND ANY INFRINGER WILL BE STRICTLY PROCEEDED AGAINST.*

**For further particulars apply to W. M. KIGHT, Secretary, AUTOMATIC COAL-GAS RETORT COMPANY, LTD., 86 and 88A, LEADENHALL STREET, LONDON, E.C.**

# WATER PURIFICATION.

*RIVER WATER and SEWAGE EFFLUENT successfully and economically treated in large volumes, by AGITATION WITH METALLIC IRON in*

## ANDERSON'S PATENT REVOLVING PURIFIER.



**No Choking of Filter-Beds.**
**Colour due to Peat and Clay entirely Removed.**
**Simple & Rapid in its Action.**
**Organic Matter Considerably Reduced.**
**Microbes Totally Removed.**

Made in Fourteen Sizes, capable of treating singly from 4000 to 1¼ Million Gallons daily.

## REVOLVING PURIFIER COMPANY, LIMITED,

*DOCK HOUSE, BILLITER STREET, LONDON, E.C.*

# HENRY BALFOUR & CO.,

**LEVEN, FIFE,**

MAKERS OF

# GASHOLDERS

And all Classes of GAS PLANT,

REVOLVING BRUSH SCRUBBERS, FOUR-WAY VALVES.

*LONDON: 13, BILLITER STREET, E.C.*

# WILLIAM INGHAM & SONS,

Incorporated with the Leeds Fire-Clay Company, Ltd.,

WORTLEY FIRE-CLAY WORKS,

Near LEEDS

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT

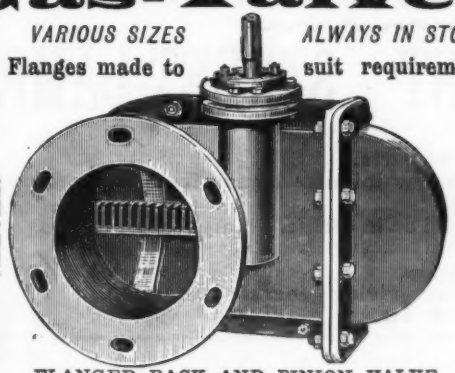
# MACHINE-MADE GAS-RETORTS.

# Gas-Valves.

*VARIOUS SIZES* *ALWAYS IN STOCK.*

Flanges made to suit requirements.

SEAL-REGULATING VALVES.



FOUR-WAY VALVES.

FLANGED RACK AND PINION VALVE.

**H. WHYTE, TIPTON, STAFFS.**

# WILSON CARTER & PEARSON,

**GAS COAL AND CANNEL FACTORS.**

Supply to any Railway Station, or for Export, all kinds of Fuel for Gas purposes.

ADDRESS CHIEF OFFICES:

**Temple Buildings, 50, New Street, Birmingham.**

# J. & W. HORTON

ETNA WORKS,

SMETHWICK,

NEAR BIRMINGHAM

(Established 50 Years),

PATENTEES

AND

MANUFACTURERS

OF

IMPROVED GASHOLDERS AND BOILERS

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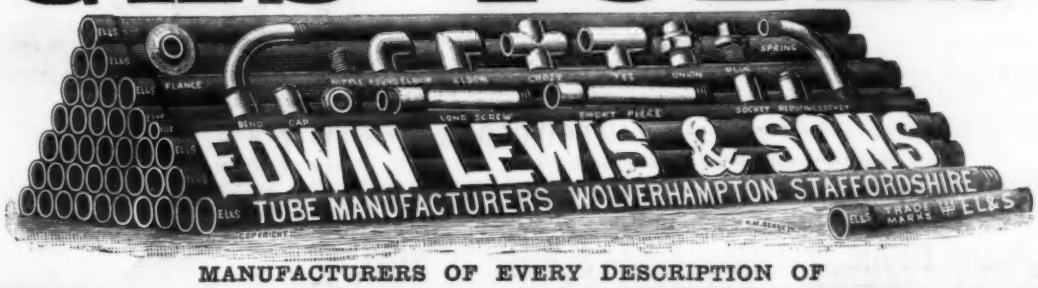


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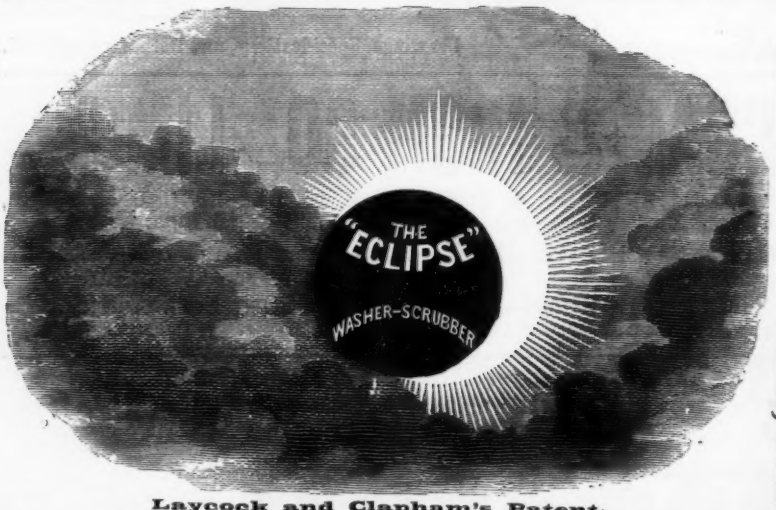


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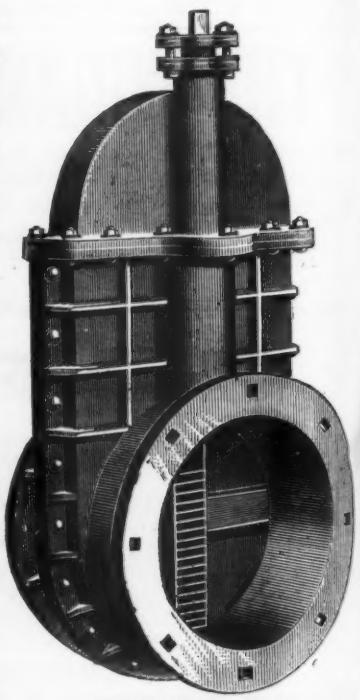

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